Effect of Armature Winding Distribution on EMF Wave Shape—*Forces Acting on Disconnecting Knife Switches and the regular operating and commercial departments*

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The Habit of Preparedness

PREPAREDNESS is a good habit in business, not a practice for only emergency or crisis. There is vital need that central stations should look ahead to safeguard their plants. The physical property represents an outlay of tangible dollars, a plant that cannot be replaced except after fatal loss of time; but its product of power can be measured in terms of national defense and safety. If a machine is crippled, it is not the loss of the machine that causes concern, but the gap in service left by the non-performance. If a tiny part in a great turbine is fractured and the giant machine is made worthless for operation, the central station man worries over the effect on service. The executive of to-day teaches his men to understand the meaning of the catastrophe which loss of power imposes upon a factory. Multiply the effect until it becomes paralysis to the body industrial in a community stretching every effort for national protection. The result shows why the central stations in many communities exposed to easy attack are receiving the protection which promotes safety.

Determining Position at Sea by Radio

THE Hydrographic Bureau has established a directive radio transmitter at Fire Island, N. Y., and is prepared to transmit special signals to ships at sea according to a system which permits any receiving station to determine its bearing from Fire Island. The sender used is in many ways similar to the German "wireless compass," in which a series of directive aerials are successively energized so that, in effect, a beam of radio waves is swept completely around the horizon. The Fire Island transmitter sends out a series of short impulses at intervals of one second, the direction of maximum radiation changing automatically by one point of the compass for each impulse. Any receiving operator within maximum range can pick up the signals when they are sent in the direction of an imaginary line connecting his station with Fire Island. If he is at less than the maximum signaling distance he may hear signals other than those sent most strongly in his direction, but the impulses which sound loudest to him will of course be those by which his bearing can be determined. Manifestly, if a non-directional signal is first transmitted broadcast to mark the beginning of a series of directive impulses, the number of seconds which elapse between receipt of this first dash and the loudest dot heard thereafter will represent the number of points of the compass from a previously agreed-upon reference direction (as, for instance, North), by which the receiving station's bearing may be fixed. If two such radio compass transmitters are operated at points on shore some 50 or 100 miles apart, a ship within range of both can determine the bearing of each, and can thus, by a simple process of triangulation, fix its own position at sea. The new installation at Fire Island is in the nature of an experiment, and its continuance, as well as the erection of similar "radio lighthouses" at other points along the coast, will depend upon the use made of it by vessels off our shores. It appears to possess great potential merit, and should prove to be of much practical utility.

Scientific Research

SCIENTIFIC research is more than an occupation or form of activity. It is an attitude of faith made manifest through works; of hope undaunted by obstacles; and of helpfulness to humanity through the discovery of new phenomena and relationships. In the older European communities this attitude has long met with official and public recognition. As a result numerous centers of research have flourished there for many, many years. Results of scientific research in time led to important practical applications, which paid a hundredfold for the earlier encouragement of pure science, not to speak of its intangible cultural value upon the masses and of the delights of the exploration and interpretation of nature.

A scientific investigator is, in a way, a venturer, but of a type wholly different from the original settlers in this country. Indeed the rough, practical pioneer attitude toward life in America is not entirely over, even now, and so the reserved European scientist, not allured by gold, or by glorius dreams of democracy, still clings to the moss-covered walls of old universities and academies of science.

But a new spirit and riper judgment have sprung up in America. Buffalo Bill is gone, and scientific research finds a congenial place, with the approaching maturity of civilized life. The need for scientific research is felt even by that wide circle of men which only a few years ago sneered at all "theory." The great European war proved to be an additional stimulus and shows clearly the great practical importance of scientific research. But even without that grim accelerator, numerous timid centers of research have sprung up here and there like frail blades of grass among unhospitable track ballast.

Promises of assistance are being given to research on all sides: by Congress, by national scientific and engineering societies, by rich benefactors, by manu-

facturing and operating companies, by institutions of learning, and by the technical press. There is a certain amount of healthy enthusiasm in this upheaval, and certainly some permanent good will result. The Research Department which appears in the ELECTRICAL WORLD for the first time this issue aims to quicken interest in the subject and we trust will not be barren of accomplishment.

N. E. L. A. Pre-Convention Plans

THE secretary's office becomes busier each day, committee meetings tread closely one upon another, correspondence is heavier, conferences are more frequent, the manufacturers make new plans, it is the beginning of the active season which culminates in the National Electric Light Association convention. Fortunately for the N. E. L. A., its committees are workers. Their reports tax the capacity of the convention program. They appear in print because members have been considering the subjects during months of preparation. They are not thrown together at the last minute to save the faces of reluctant committeemen. They are looked for with eagerness because the business grows, its problems ever increase, its responsibilities are insistent. And besides the meetings to discuss the convictions formed by the committees we note with pleasure that the manufacturers will have a large part in the convention sum total this year. Exhibit space is almost double that obtainable in former years; hence more effective, attractive displays worth seeing.

Forces Acting on Disconnecting Switches

IT is a well-known fact that when an electric current flows around a loop of conductor, such as a loop of wire laid on the ground, the loop tends to enlarge its area. This is true whichever way the current flows around the loop. That is to say, electromechanical forces are brought into play tending to extend the boundary of the loop. By virtue of the current carried around the loop, the latter becomes ambitious for a larger place in the sun, and, unless restrained, expands with a force which increases as the square of the current. The facts may be explained either on the Amperian principle that each little element of conductor in the loop repels other elements with an electrodynamic force; or on the Maxwellian principle that the magnetic flux linked with the loop absorbs and contains a certain amount of energy. This flux depends upon the mmf. and permeance of the magnetic circuit of the loop in Ohm's-law fashion. The mmf. of a steady current of, say, 100 amp. in one turn will be 100 amp.-turns or 125.7 gilberts; but the permeance of the loop will increase with its area. If the area of the loop is doubled, the permeance of the magnetic circuit will ordinarily not be so much as doubled; but will nevertheless be considerably increased, with a corresponding increase in the total magnetic energy. The forces tending to enlarge the area of the loop are determined by the increase of energy per unit of outward linear displacement. If 1 cm. of outward movement will involve a large increase of energy, the outward tendency, or shove, will be correspondingly large. With a continuous current the shove will be continuous; with an alternating current it will be pulsatory but always in the same direction.

In the case of a switchblade opening outward from the bars or conductors to which it is attached, the current always tends to push open the switch. This is the ordinary mechanical arrangement. If on the contrary the switch were made to open inwardly toward the supporting busbars the current would tend to hold it tightly closed. The mechanical force involved increases with the square of the current and is greater with long than short knifeblades, other things being the same. Ordinarily the electromechanical force on an active switchblade is not very great and is seldom large enough to obtrude itself on the operator's notice; but in cases of powerful load currents, or of short-circuits, these forces may readily be large enough to open a tightly gripped switchblade.

The subject of this switch-opening force is dealt with quantitatively in an article of this issue by Julian Loebenstein which appears to present a satisfactory agreement between the results of theory and experiment.

Engineering Aspects of the Copper Situation

THE outlook for the electrical industries as regards copper, their prime necessity, cannot be regarded as particularly cheerful. Nobody was surprised that the price shot upward under the pressure of the European war, but its persistent adherence to the high level in spite of greatly increased activity in mining, smelting and refining, is a matter of grave import. To electrical companies, anxious to increase their service to meet public demands, copper at 40 cents a pound or thereabouts is a very grave matter and many a promising extension has been temporarily abandoned on account of the forbidding initial investment. The war shows no great prospects of cessation within a considerable period, and if the United States enters the fight there will be a still greater call for munitions and a demand for copper as yet unprecedented. In the face of these conditions remedial measures should be earnestly sought.

They can be looked for along three separate lines. First, one may go into substitution of aluminum or even iron for copper. The first named, owing to conditions surrounding its production, is kept at a price not far below the equivalent price of copper for conducting purposes. There is difference enough, however, to yield some encouragement for the installation of aluminum line wires wherever an overhead conducting system is used. However, since the war aluminum has been hard to obtain and many transmission companies have found it profitable to sell their aluminum lines and substitute copper ones. The second alternative has been discussed in our columns several times of late. It meets one requirement of the situation successfully, that is, the construction of long cheap

iron wire lines for picking up comparatively light loads which would be hardly profitable at the investment in copper which would be otherwise required. When it comes to heavier service, however, some difficulties are encountered. It must not be forgotten in this connection that pretty heavy inductance can be taken care of by synchronous condensers, and in cases where the load to be assumed is sufficient to justify this measure there would seem to be a good prospect of success in working out an iron line which would considerably improve the situation.

Then there is the natural recourse for saving of conductor material, by raising the voltage. As regards transmission lines this measure is already in active progress and should be pushed wherever the conditions begin to demand decrease of line loss. With respect to distribution systems the case is not so easy. Yet considerable relief can be gained in a very large number of cases by passing from the ordinary three-phase distribution to the star connection with neutral, a step which has already been taken in a few plants and which would pay in many more. Where four wires are not available one could fall back on aluminum or even iron for the neutral, and the process of changing over can be carried out with a good deal of facility. Such a rearrangement is far easier in fact than it seems to be when the suggestion is first made. The chief thing for which a keen eye must be kept out is interference by trees which is, of course, more severe at the increased voltage between phase wires.

Finally, one has to meet conditions where extensions are seriously interfered with by high cost of installation and something must be done to keep up the normal growth of business. Under such conditions intensive use of existing distributing system is the obvious step to be taken. The problem is to get every kilowatt upon the lines which it is possible to accommodate, and particularly to even up the use as far as possible so as to keep copper in full service. If there ever was a time when necessity called for activity in building up off-the-peak load that time is now. The subject indeed has been widely discussed in a general way, and the present enormously high price of copper makes it exceptionally pertinent. The sales department of every central station can do no better service than in getting busy and specializing so far as possible on the branches of service which will not tend to overload the lines. Perhaps the cost of conductors may prove a blessing in disguise by stimulating the growth of every kind of off-the-peak load. In the search for this desideratum care should equally be taken to go slowly on the assumption of load which will add to the peak, while making a determined drive to get the more desirable and profitable employment for the energy generated.

Part-Slot Fractional-Pitch Windings

IT is now generally admitted that an alternating-current generator should develop a pure sine wave of emf., as nearly as practicable, under all conditions of load. Departures from the simple sinusoidal wave form not only tend to produce weaknesses and cross-magnetizing currents between machines operating in parallel; but they also tend to set up serious induced disturbances in neighboring telephone systems.

At one time it was supposed that the best way to insure the production of a smooth sine wave of generated emf. was to provide a sine wave of magnetic flux density between the field poles and armature at no load; or to provide what designers call a sinusoidal field form. Any single conductor advancing through such a sinusoidal field form would develop a sinusoidal emf. in its own element. But under the distorted magnetic conditions of lagging or leading current delivery, the tendency of ordinary loads is to distort the field form, and with it the emf. wave in each conductor. In recent years, it has come to be recognized that by the use of fractional pitch windings it becomes possible to produce an approximately sinusoidal resultant generator wave, even although the field form was considerably distorted. Moreover, by the same procedure, the distorting influence of lagging current delivery on the generator emf. wave, under load, could likewise be reduced.

The article this week by Theodore Schou, on the subject, is a plea for the use of fractional-slot as well as fractional-pitch windings, in designing alternators for good wave form with the most economical utilization of materials. The oscillographs presented with the article give a good indication of what can be done in this manner, to keep the generated emf. wave smooth even when the field form is considerably distorted. Moreover, part-slot fractional pitch designs help to minimize the mechanical and magnetic vibration of the machine when in operation, and so to reduce the noise of running. The article should be carefully studied by those who are interested in either the design or operation of polyphase generators.

The Coming Issues

EMPHASIS will be laid in the next issue of the ELECTRICAL WORLD, March 24, on central station commercial problems of a managerial nature. Of special interest in that issue will be an article on "Shall the Central Station Maintain a Wiring Department?" Few problems are more pressing or receiving more careful attention by thinking managers than the wiring of buildings and residences. The ideas and experiences of a number of progressive central station companies have been analyzed with a view of ascertaining how great and how sincere is the co-operation existing between lighting companies and the local electrical contractors. The conclusion reached is one that every commercial manager may well ponder and consider. In the fifth issue in March the electrical layout and operating features of a large New England cotton mill will be described. ELECTRICAL MERCHANDISING for March, out this week, is replete with valuable suggestions for sales managers and contractors.

Part-Slot Fractional-Pitch Windings

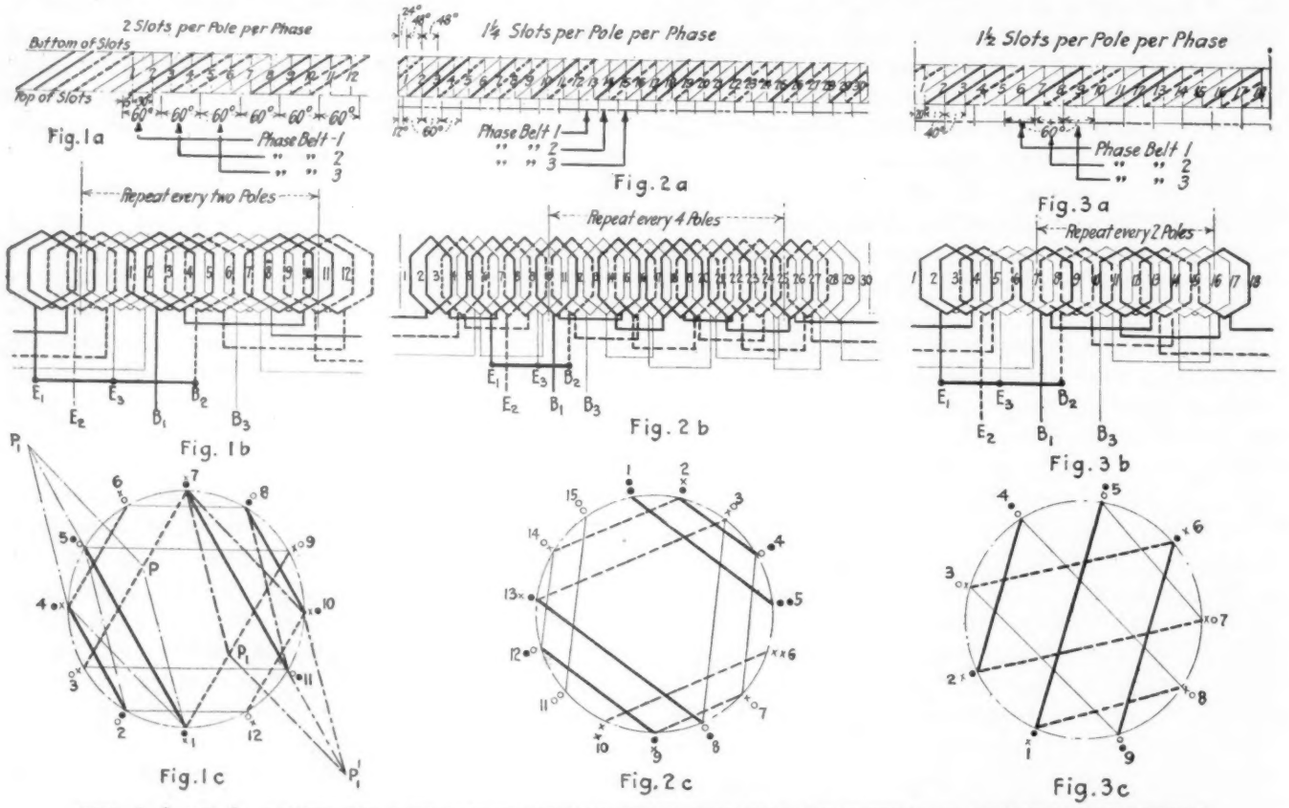
Effect of Armature Winding Distribution on the Electromotive Force Wave Shape as Generated by Non-Sinusoidal Field Forms, with a Discussion of Fractional-Slot, Fractional-Pitch Windings and Their Application

BY THEO. SCHOU
The State University of Iowa

WITH a given pole or a certain fixed field form which is not sinusoidal, the distribution of the armature winding and the connection thereof has more or less effect on the wave form generated. It is also generally known that by using a "chorded" or fractional-pitch winding the wave form may be improved above that generated by a pitch winding, other things being equal.

In most cases of manufacture the number of armature slots per pole is a multiple of the phases. In order to use the same armature punching or the same armature for both two and three-phase windings, the number of slots per pole is made a multiple of two as well as since a well-designed machine of this nature will have a rather flat field form with a small air gap and poles embracing 70 to 75 per cent of the pole pitch, it is quite obvious that the generated wave will deviate more or less from a sine wave, depending on the connections of the phases as will be demonstrated later.

As mentioned before, "chording" or applying a fractional pitch winding may tend to improve the wave form, and a winding having a throw of about 83 per cent of the pitch or a chord factor of 0.966 seems to have the tendency, in case of star connection, to reduce the larger higher harmonics to a minimum. For both economical and technical reasons, disregarding the reduction in reactance, chording the winding is most desirable with high-speed machines, having a large pole pitch. Since the reactance of high-speed machines such as turbo-generators is inherently small, the high-frequency current in delta-connected machines may be serious if the third harmonic is in strong evidence. In the case of a low-speed machine, where the pole pitch is small and the armature core rather long in proportion to the pitch or "throw" of the coil, it might not be desirable to apply a chorded winding. This is evident since a chorded winding having the same number of effective conductors per slot as the pitch winding necessarily must have more conductors per slot.



FIGS. 1, 2 AND 3—LAYOUT FOR PART-SLOT FRACTIONAL-PITCH WINDINGS AND METHOD OF CHECKING CORRECTNESS

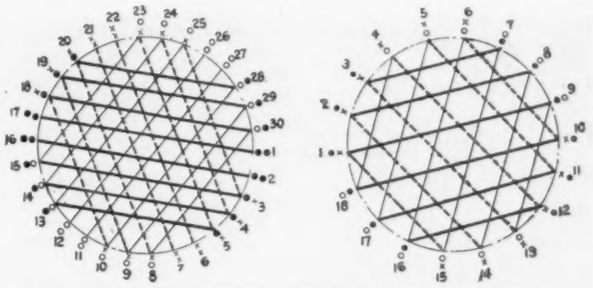
Illustrations 1, 2 and 3 refer to three-phase star-connected windings with two, one and one-fourth and one and one-half slots per pole per phase and having coil throws of 1 and 4. The upper row of drawings are developed plans of the slots and represent the throws of the coils. The diagrams below indicate the corresponding winding connections. From these are worked out the circle diagrams below showing the voltage relations.

of three. An increase in the number of slots per pole per phase will have a tendency to improve or smooth out the wave, provided the number of slots per pole remains a whole number. For high-speed machines or machines with few pole pairs it is generally desirable and possible to have a large number of slots per pole. For low-speed machines or machines with a large number of pole pairs and moderate capacity, however, this condition is not so desirable either from the economical or technical viewpoint. Since a well-designed low-speed machine with moderate capacity has a rather limited or small-pole pitch, it is not possible or desirable, in most cases, to use more than six slots per pole. Furthermore,

When sinusoidal waves are developed, chording the winding decreases the number of effective conductors, and thus the voltage induced in proportion to the sine of half the electrical angle embraced by the coil or the chord factor f_{ch} is a constant. The reciprocal of the latter gives the increase of total conductors per coil or per slot necessary to obtain the same voltage as with pitch winding, other things being equal. If there is more than one slot per pole per phase, a winding factor or "spread-factor" f_w is introduced which depends on the number of slots per pole per phase and compensates for the angular displacement of the slots per pole per phase. This factor is the ratio between the geometrical and arithmetical sum of the different emfs. induced in the conductors of the different slots per pole per phase. The product of factors f_{ch} and f_w may be found conveniently by a graphical method. For the benefit of readers not familiar with fractional-pitch or fractional-slot windings, a novel and practical method of laying out any winding of this description will be discussed in what follows.

Looking at the end of a three-phase armature having two coils per slot, two slots per pole per phase, and a coil throw of 1 and 4, the end connections of the coils may be represented as shown in Fig. 1a. The slots are represented as straight vertical lines and are located according to the electrical angles between them. Thus by laying out the three-phase belts 60 deg. apart (for three-phase windings) from any convenient point, say between two slots, and keeping in mind that coils of one phase can throw from its own phase belt only, the whole winding arrangement is really determined as soon as enough is laid out so that it begins to repeat itself (see Fig. 1a). From the diagram of end connections a wiring diagram can be developed as in Fig. 1b, which represents star connected phases, and is suitable for any number of pole pairs. If the number of slots in which a winding is complete be spaced in a circle and the distribution of phases in the different slots be designated, then by drawing parallel lines between slots containing corresponding phase windings and designating these parallel lines, the vector diagram (Fig. 1c) thus obtained will show balance if the winding is correct. For the minimum number of pole pairs possible with such a winding, there will be as many parallel phase lines as there are coils per phase.

Evidently the diameter of the circle (Fig. 1c) is proportional to the induced, pitch-coil voltage, and any chord between any two slots is proportional to the induced voltage of the chorded coil. For a winding repeating every two poles this chord may be scaled, but if the winding does not repeat every two poles or, in other words, cannot be used for a two-pole machine, then the length of the chord must be calculated, using the proper electrical angle between slots embraced by the coil. The sum of the lengths of all parallel phase lines divided by the sum of as many diameters as there are phase lines taken gives the product of the chord factor and spread factor ($f_{ch} \times f_w$).

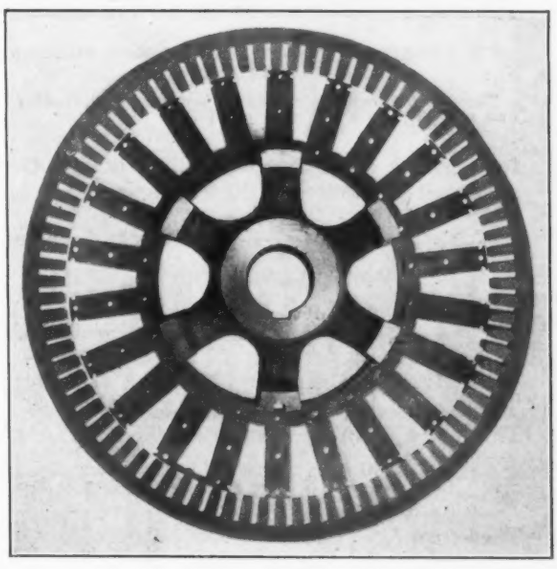


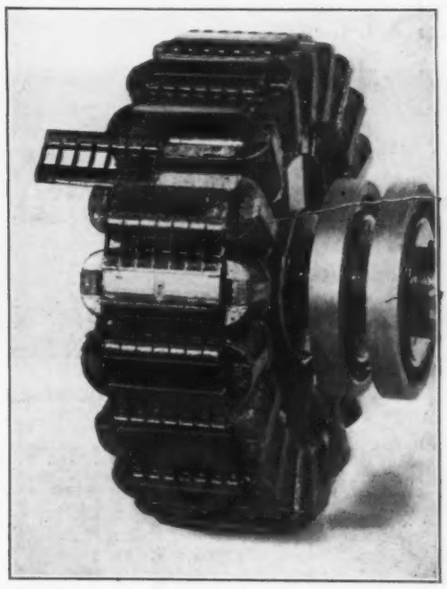
FIGS. 4 AND 5—VOLTAGE RELATIONS IN THREE-PHASE STAR-CONNECTED WINDINGS

The diagram at the left represents conditions with five slots per pole per phase and the one at the right three slots per pole per phase. The five-slot winding has a coil throw of 1 and 13 and the three-slot a throw of 1 and 7.

Referring to Fig. 1c, the combined induced voltage of coil 1 and 4 and coil 2 and 5 is proportional to the vectorial (geometrical) sum of vector 1-4 and vector 2-5 or vector 1-P_1. If the diameter of the circle is 1, then vector 1-4 = vector 2-5 = $1 \times \sin 1/2\ (3 \times 360/12)^\circ$ $= 1 \times \sin 45^\circ = 0.707$. Vector 1-$P_1$ $= 2 \times 0.707 \times \cos 15^\circ = 2 \times 0.707 \times 0.966 = 1.366$. But vector 2-4 + vector 1-5 $= 1 \times \sin 30^\circ + 1 \times \sin 60^\circ = 0.5 + 0.866 = 1.366$. As vector 1-$P_1$ = vector 7-P_1', it follows that

$$\frac{\overline{8\text{-}10} + \overline{7\text{-}11} + \overline{5\text{-}1} + \overline{4\text{-}2}}{4 \times 1} = \text{geometrical sum of induced}$$





FIGS. 6 AND 7—ARMATURE PUNCHING, FIELD PUNCHING AND ASSEMBLED ROTATING FIELD OF LOW-SPEED SMALL-POLE PITCH REVOLVING-FIELD ALTERNATOR

This machine has eighty-four open armature slots, absolutely even field-pole spacing, 5/64-in. air gap and a pole pitch of only 4 in. measured on the armature surface. This construction was made possible by the use of part-slot fractional-pitch windings. One of the "damper bridges" used between the pole tips is shown partly wthdrawn. This machine was designed by the writer.

voltage ÷ arithmetical sum of induced voltage, or $\frac{0.5 + 0.866 + 0.866 + 0.5}{4} = \frac{2.73}{4} = 0.683 = f_{ch} \times f_w$.

As the chord factor f_{ch} can always be quickly determined, the spread factor can also be found. In this case f_{ch} = sin (90/2)° = sin 45° = 0.707 and f_w = 0.683 ÷ 0.707 = 0.966.

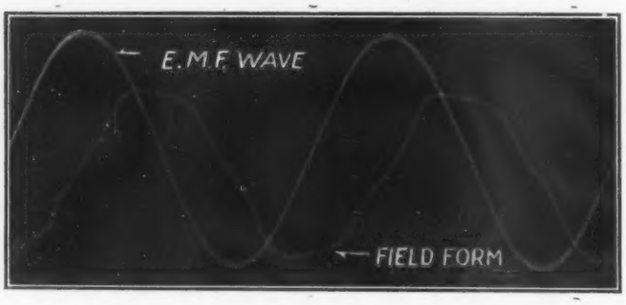


FIG. 8—FIELD FORM AND CORRESPONDING EMF. WAVE PRODUCED BY PART-SLOT* ALTERNATOR CARRYING NON-INDUCTIVE LOAD

These oscillograms refer to the alternator, parts of which are shown in Figs. 6 and 7. The curves show that a practically sine wave of emf. is produced even with a non-sinusoidal field form.

Figs. 2a, 2b and 2c show the method of laying out and developing the winding and applying the circle diagram for a three-phase, star-connected part or fractional-slot,* fractional-pitch winding with one and one-fourth slots per pole per phase and a coil throw of 1 and 4. As will be noted, this winding repeats every four poles and therefore can be applied only to a machine having four poles or a multiple thereof. Since there are three and three-quarter slots per pole, the electrical angle between the slots is 180 ÷ 3.75 = 48°.

The product $f_{ch} \times f_w$ will be equal to the sum of the five parallel phase lines divided by five times the circle diameter. (In Fig. 2c note that two-phase lines appear as one through slots 1-5, 6-10 and 11-15.) If the circle diameter = 1, then

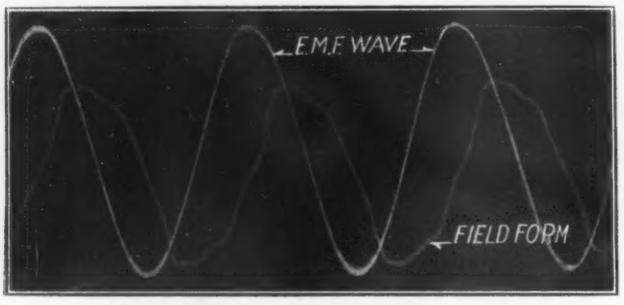


FIG. 9—EMF. WAVE AND CORRESPONDING FIELD FORM FOR PART-SLOT* ALTERNATOR CARRYING INDUCTIVE LOAD

These curves also refer to the alternator, parts of which are shown in Figs. 6 and 7. The oscillogram was taken with an inductive load as indicated by the crowding of magnetic flux to one side of each pole (see field form). Even with this non-sinusoidal field the emf. is a sine wave.

Vector 2-4 = 1 × sin 48 deg. = 0.743
2 × vector 1-5 = 2 × sin 96 deg. = 2 × sin 84 deg. = 1.989
vector 13-8 = 1 × sin 120 deg. = sin 60 deg. = 0.866
vector 12-9 = 1 × sin 72 deg. = 0.951
and their sum = 4.549

Therefore $f_{ch} \times f_w = 4.549 \div 5 = 0.91$.
Now f_{ch} = sin 0.5(3 × 180/3.75) deg. = sin 72 deg. = 0.951.
Therefore $f_w = 0.91 \div 0.951 = 0.957$.

The circle vector diagram for a three-phase, star-connected winding with five slots per pole per phase and a coil throw of 1 and 13 is shown in Fig. 4. From this diagram the following relation is obtained:

$$f_{ch} \times f_w = \frac{(\overline{20\text{-}28} + \overline{19\text{-}29} + \overline{18\text{-}30} + 2 \times \overline{17\text{-}1}) \times 2}{10}$$

But, vector 20-28 = sin 48 deg. = 0.743
vector 19-29 = sin 60 deg. = 0.866
vector 18-30 = sin 72 deg. = 0.951
2 × vector 17-1 = 2 × sin 84 deg. = 1.989
and their sum = 4.549

Therefore $f_{ch} \times f_w = \frac{2 \times 4.549}{10} = \frac{4.549}{5} = 0.91$.

And as f_{ch} = sin 0.5 $\left(\frac{180}{15} \times 12\right)^\circ$ = sin 72 deg. = 0.951,

$f_w = 0.91 \div 0.951 = 0.957$.

Thus the spread factor for a three-phase winding having five slots per pole per phase is equal to the spread factor of a part-slot winding having one and one-quarter slots per pole per phase.

Represented in Figs. 3a, 3b and 3c is a three-phase, star-connected part-slot winding with one and one-half slots per pole per phase and a coil throw of 1 and 4. This winding repeats itself every two poles and therefore can be applied to a machine having two poles or any multiple thereof. Referring to Fig. 3c,

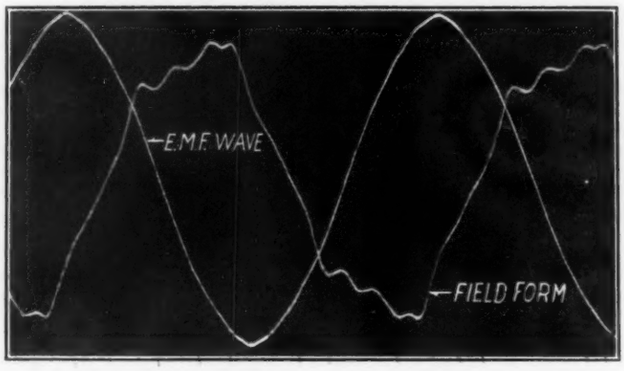


FIG. 10—EMF. WAVE AND FIELD FORM OF ALTERNATOR WITH PART-SLOT* WINDING

This oscillogram refers to a low-speed alternator having one and one-half slots per pole per phase.

$$f_{ch} \times f_w = \frac{\overline{2\text{-}4} + \overline{1\text{-}5} + \overline{9\text{-}6}}{3} \text{ (circle diameter = 1)}$$

Vector 2-4 = sin 40 deg. = 0.643
vector 1-5 = sin 80 deg. = 0.985
vector 9-6 = sin 60 deg. = 0.866
and their sum = 2.494

Therefore $f_{ch} \times f_w = 2.494 \div 3 = 0.833$.
The factor f_{ch} in this case = sin 0.5

$$\left(\frac{180}{4.5} \times 3\right)^\circ = \text{sin } 60 \text{ deg.} = 0.866.$$

Therefore $f_w = 0.833 \div 0.866 = 0.96$.

Referring to Fig. 5, which shows the vector circle diagram for a three-phase, star-connected winding with three slots per pole per phase and a coil throw of 1 and 7,

$$f_{ch} \times f_w = \frac{(\overline{3\text{-}7} + \overline{2\text{-}8} + \overline{1\text{-}9}) \times 2}{6}$$

But vector 3-7 = sin 40 deg. = 0.643 (circle diam. = 1)
vector 2-8 = sin 60 deg. = 0.866
vector 1-9 = sin 80 deg. = 0.985
and their sum = 2.494

Therefore $f_{ch} \times f_w = \frac{2.494 \times 2}{6} = \frac{2.494}{3} = 0.833$.

*A part slot winding is also a chorded winding.

Since $f_{ch} = \sin 0.5\left(\frac{180}{9} \times 6\right)$ deg. $= \sin 60$ deg. $= 0.866$.

Then $f_w = 0.833 \div 0.866 = 0.96$.

Thus the spread factor of a three-phase winding having three slots per pole per phase is equal to the spread factor of a part-slot winding having one and one-half slots per pole per phase. From this the conclusion may be drawn that the distribution of a part-slot winding having three and three-quarter slots per pole is, so far as distribution is concerned, electrically equivalent to fifteen slots per pole. A part-slot winding having four and one-half slots per pole is equivalent to nine slots per pole. Or, in general, a part-slot winding has the effect electrically of many narrow slots per pole, which is very desirable as the economical value of such a winding relative to the equivalent in a whole number of slots per pole is self-evident. Part-slot windings have the additional advantages (1) of enabling the building of low-speed machines with a frame bore, that would prohibit even six slots per pole, (2) of practically eliminating dead points at starting with synchronous motors, and (3) effectively reducing magnetic noise.

EFFECT OF ARMATURE WINDINGS ON EMF. WAVE

In the following will be analyzed the effect of different armature windings on the electromotive wave form, when the same field form or flux distribution curve exists. Fig. 11 shows the field form of a low-speed alternator such as is often met with in practice except that the effect of tooth harmonics or of the armature slots on the field form has been omitted. This field form has been resolved into its fundamental and higher harmonics, including the third, the fifth, the seventh and the ninth drawn to scale. The maximum field strength of that part of the pole which has the minimum air gap is designated as 100. The harmonics above the ninth are not indicated since their effect compared with the lower frequency waves is very small, their values being

To demonstrate the effect of different windings on the emf. wave it will be assumed that conductors of different armature windings are moved through this field and the resulting instantaneous values will be plotted, giving the corresponding emf. wave shape. Only windings with two coils per slot will be considered in this discussion. Fig. 12a represents the emf. wave form gen-

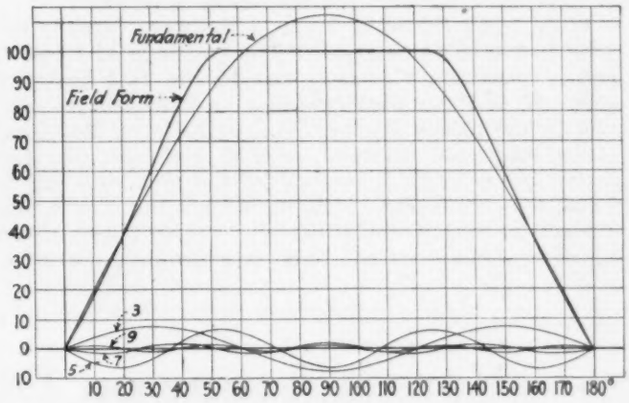
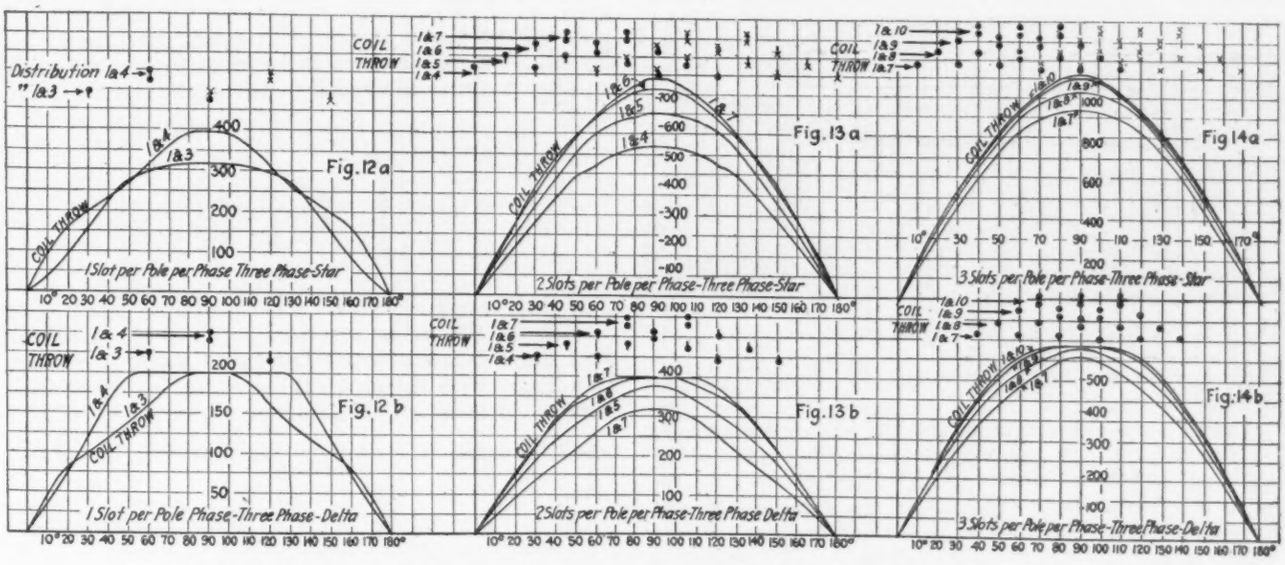


FIG. 11—FIELD FORM OFTEN OBTAINED WITH ALTERNATORS

erated under these conditions by three-phase, star-connected armature winding having three slots per pole, or one slot per pole per phase and a coil throw of 1 and 4, and 1 and 3 (chorded 66.6 per cent). The wave form resulting from a throw of 1 and 4 has a maximum deviation from the equivalent sine wave of 7.38 per cent. The effect of the third, ninth, fifteenth, etc., harmonics is eliminated by the connection of phases in star, but the other harmonics are in evidence. Slight improvement is shown by the use of throw 1 and 3 as the maximum deviation from the equivalent sine wave is 6.7 per cent. Chording the winding 66.7 per cent of the full pitch has reduced the fifth, seventh, seventeenth and nineteenth harmonics to approximately 87 per cent



FIGS. 12, 13 14—EMF. WAVES PRODUCED BY DIFFERENT THREE-PHASE WINDINGS WITH VARIOUS COIL THROWS

All the curves refer to three-phase windings. The diagrams at the left refer to windings with one slot per pole per phase, the middle set to windings with two slots, and the right-hand diagrams to three-slot windings. The winding connection and the coil throw are indicated near each curve

as follows: Eleventh, 0; thirteenth, —0.693; fifteenth, +0.0666; seventeenth, +0.1175; nineteenth, —0.158; twenty-first, +0.0476; twenty-fifth, —0.04; twenty-seventh, +0.037; twenty-ninth, +0.0345; thirty-first, +0.0194. The maximum deviation of this field form from an equivalent sine wave is 11.2 per cent and the form factor is 1.1.

of their full values. In order to obtain a good wave form with such a winding the pole could be so shaped as to give a field form which approximates a sine wave. However, this would require either a larger machine or an increase of about 12 per cent in the number of effective conductors per slot, provided the machine is operated magnetically the same with both field forms.

The voltage wave for the same winding and throw as shown in Fig. 12a, but with delta-connected phases, is indicated in Fig. 12b. In this case the pitch throw (1 and 4) will produce a wave with exactly the same (amplitude included) harmonics as exist in the field form, therefore the voltage wave form is identically the same as the field form, having a maximum deviation of 11.2 per cent from the equivalent sine wave.

With a coil throw of 1 and 3 the wave form is exactly like that which resulted from a throw of 1 and 4, and star-connected phases, due to the fact that the effect of 66.7 per cent chording is equivalent to connecting the phases in star. This wave form, therefore, has a maximum deviation of 7.38 per cent. As the chord factor for 66.7 per cent of the pitch winding is 0.866, the crest value of the wave for a throw of 1 and 3 would be 86 per cent of that for a pitch throw, if the waves were sine waves. This condition does not exist, however, with the wave forms indicated in Figs. 12a and 12b, that show 80 per cent and 100 per cent respectively.

Figs. 13a and 13b represent the emf. wave forms of a three-phase winding having two slots per pole per phase with a throw of coil 1 and 7 (pitch), 1 and 6, 1 and 5 and 1 and 4, the connections being star in the first case and delta in the second. It may be noted that the wave for throw 1 and 7, Fig. 13a, is exactly like the wave for throw 1 and 5, Fig. 13b, as chording 1 and 5, or 66.7 per cent of pitch, is equivalent to connecting the phases in star.

The curves in Figs. 14a and 14b show the effect of three slots per pole per phase, with star and delta-connected phases and coil throws of 1 and 10 (pitch), 1 and 9, 1 and 8 and 1 and 7. Other discussions along this line will be presented in a later issue of the ELECTRICAL WORLD.

Forces Acting on Disconnecting Switches

Results of Tests to Determine the Forces Tending to Open Knife Switches When They Are Subjected to Excessive Current Overloads, with Calculations Based on Different Conditions

BY JULIAN LOEBENSTEIN, E.E.

TESTS were recently conducted by the writer to determine the forces tending to open disconnecting switches when carrying excessive currents. In what follows the results of these tests are given, together with calculations essential to the proper design and construction of catches for disconnecting switches. For an arrangement of switch and bus, as shown in

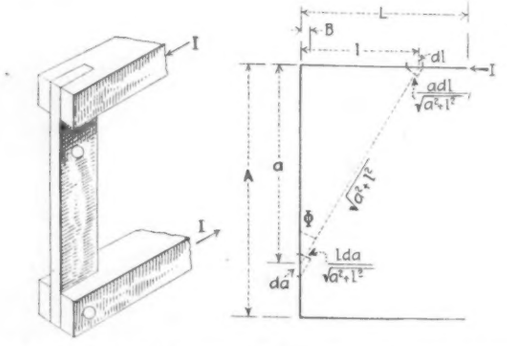


FIG. 1—FORCES ACTING ON A DISCONNECTING SWITCH

Fig. 1, with a current I flowing, the analysis of conditions follows:

Consider an element dl on the bus and an element da on the switch. If the various distances involved be assigned letters as shown in the diagram we may resolve the two elements da and dl into parallel elements perpendicular to the line joining their centers. These elements will be $\frac{a \times dl}{\sqrt{a^2+l^2}}$ and $\frac{l \times da}{\sqrt{a^2+l^2}}$ The repulsive force between these two elements will be proportional to the product of the currents and inversely proportional to the square of the distance between the elements.

$$dF = \frac{kI^2aldadl}{(a^2+l^2)^2}$$

The horizontal component of the force will be

$$dF_h = dF \sin \varphi = \frac{kI^2al^2dadl}{(a^2+l^2)^2\sqrt{a^2+l^2}}$$

and the torque due to the interaction

$$dT = \frac{kI^2al^2dadl}{(a^2+l^2)^2\sqrt{a^2+l^2}}(A-a)$$

$$T = kI^2\left[\int_0^L\int_0^A \frac{Aal^2dadl}{(a^2+l^2)^2\sqrt{a^2+l^2}} - \int_0^L\int_0^1 \frac{a^2l^2dadl}{(a^2+l^2)^2\sqrt{a^2+l^2}}\right]$$

It will be found easier to integrate by keeping the denominator in the form given than to put the entire expression under the radical. Integrating with respect to A

$$T = kI^2\left[\int_0^L \frac{Adl}{3l} - \int_0^L \frac{Adl}{3\sqrt{l^2+A^2}}\right]$$

In integrating the first integral of this last expression an infinite value would be obtained by taking the limit zero, hence a small but finite value B is used. This fits in with the physical consideration, for if there were an element on the bus not separated by a finite distance from an element on the switch blade there would be an infinite force.

TABLE I—TORQUE IN POUNDS AT ONE FOOT FOR I =20,000 AMP., A =12 IN.

L	B =.5 In.	B =0.1 In.	B =0.01 In.
2	2.1	4.2	7.2
6	3.9	6.1	9.1
12	5.1	7.2	10.2
20	5.7	7.8	10.8
30	5.9	8.1	11.1
40	6.1	8.2	11.2

Integrating with respect to L

$$T = \frac{kI^2A}{3}\left[\log \frac{AL}{B(L+\sqrt{L^2+A^2})}\right]$$

This, however, is the torque due to the reaction between the upper bus and the switch blade. The torque due to the reaction between the lower bus and the switch blade will be given by an integral similar to the second one in the original torque equation. This is $\frac{AL}{3\sqrt{L^2+A^2}}$. Hence the expression for the torque due to both buses is

$$T = \frac{kI^2A}{3}\left[\log \frac{AL}{B(L-\sqrt{L^2+A^2})} + \frac{L}{\sqrt{L^2+A^2}}\right]$$

where T = pounds at 1 ft.; $k = 0.1875 \times 10^{-8}$; and A, L and B are measured in inches.

To show the effect of assuming different values for B Table I was calculated and plotted (see Fig. 4).

It is probable that the value $B = 0.1$ in. represents most nearly the actual conditions, and therefor gives the correct values for the torque. On this basis the Table II showing variation of torque with current was calculated (see Fig. 2).

TABLE II—TORQUE IN POUNDS AT ONE FOOT FOR A = 12 IN. — L = 12 IN. — B = 0.1 IN.

Amperes Current	Torque
10,000	1.8
20,000	7.2
30,000	16.2
40,000	28.8
50,000	45.0
60,000	64.8
70,000	88.2
80,000	115.2
90,000	145.8
100,000	180.0

In order to determine the actual torque necessary to open a switch by hand, various switches were tested by means of a hand balance. The hook of the balance was attached in the hook hole of the switch and increasing tension applied in a direction normal to the switch until the switch started to open. This tension necessary to start the switch caused it to leave the "break jaw" after an application of one second or more.

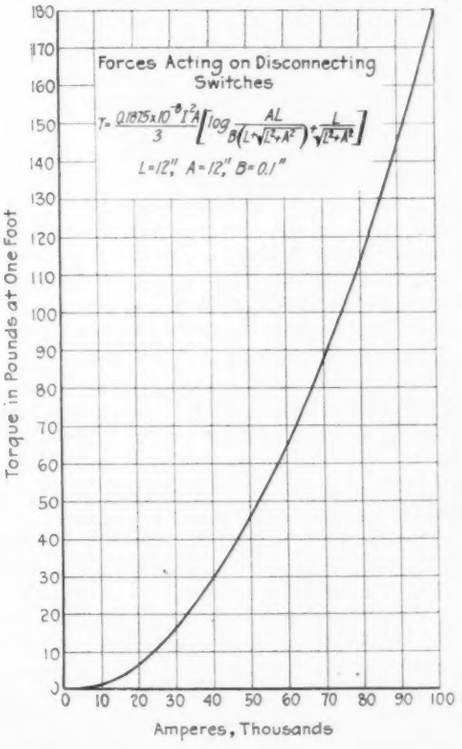

Forces Acting on Disconnecting Switches
$T = \frac{0.1875 \times 10^{-8} I^2 A}{3}\left[\log \frac{AL}{B(L-\sqrt{L^2+A^2})} + \frac{L}{\sqrt{L^2+A^2}}\right]$
L=12", A=12", B=0.1"
Torque in Pounds at One Foot
Amperes, Thousands

FIG. 2—VARIATION OF TORQUE WITH CURRENT

The following styles of switches were tested: Two 600-amp. single blade and a 1200-amp. double blade. Both styles have a distance of 12 in. between the center line of the jaws and the pivot and 9.75 in. between the center line of the hook hole and the pivot. The tests showed a tension of 20 lb. necessary to open the 600-amp. switch and 40 lb. to open the 1200-amp. switch. The torque necessary is therefore 16.25 lb. at 1 ft. for the 600-amp. switch and 32.5 lb. at 1 ft. for the 1200-amp. design.

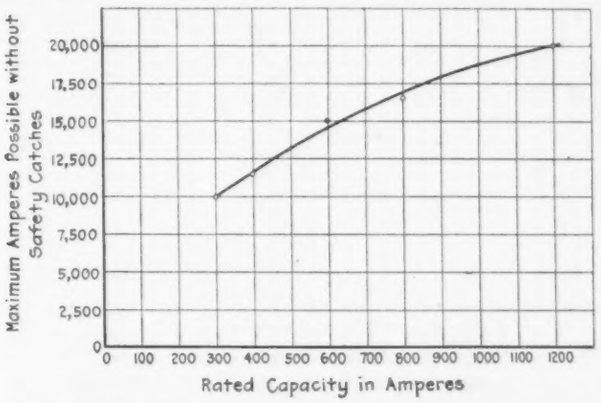


FIG. 3—APPROXIMATE RATING 15,000-VOLT SINGLE-POLE, SINGLE-THROW, BACK-CONNECTED SWITCHES

The General Electric Company recommends the ratings indicated in Fig. 3 with 15,000-volt single-pole, single-throw, back-connected switches. The pressure between the blade and the clips is the limiting feature, and these values must therefore be used accordingly.

These recommendations agree closely with the results found by the mathematical analysis. A root mean square current of 20,000 amp. would give a maximum current of 30,000 amp. with a corresponding torque of 16 lb. at 1 ft. The test showed that this was the torque required to open a single-blade 600-amp. switch, so that it may be assumed that a 1200-amp. single-blade switch would require a slightly higher torque, thus leaving a slight margin of safety. Hence the recommendation of 20,000 amp. as the limiting current for a single-blade 1200-amp. switch seems to be correct. Other switches could, of course, be estimated from the curves and data given.

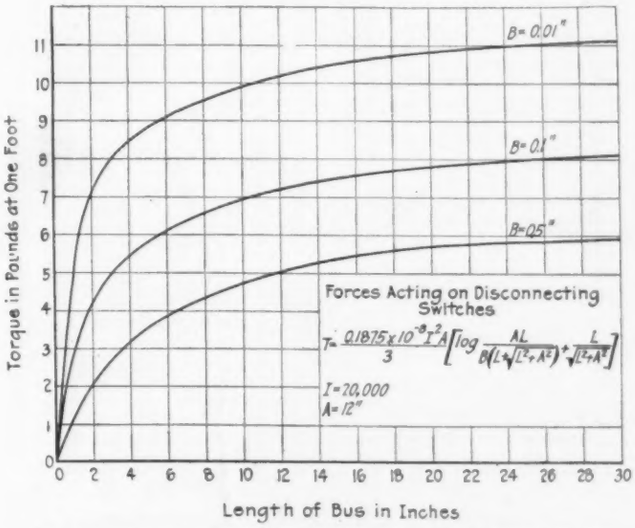
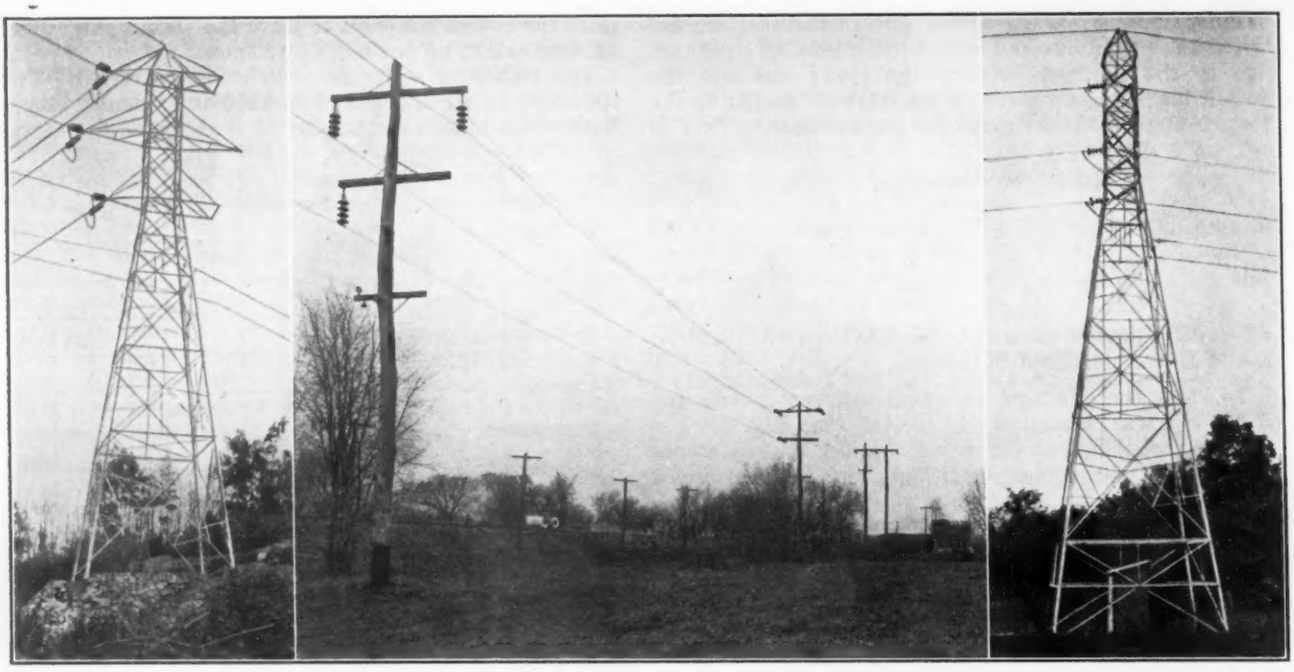


FIG. 4—TORQUE FOR DIFFERENT WIDTHS OF SWITCH BLADE AND LENGTHS OF BUS



Tieing Together Water and Steam Power

Completion of an Article on Arrangements Made by the Connecticut Power Company to Operate its Falls Village Hydroelectric Plant in Parallel with the Hartford Electric Company's Steam Plant

FEATURES of the Falls Village hydroelectric plant of the Connecticut Power Company were described in the March 3 issue of the ELECTRICAL WORLD. In this article the construction of the transmission system is described and data presented showing how the water and steam plants share the loads in typical wet and dry months.

The routes followed by the transmission lines and the locations of the substations and generating stations are indicated on an accompanying map. Between Falls

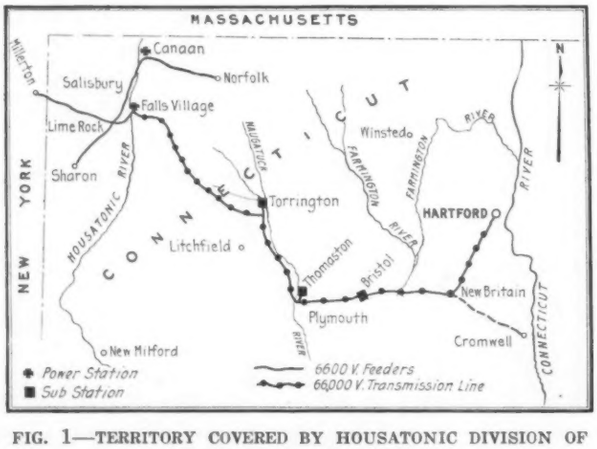


FIG. 1—TERRITORY COVERED BY HOUSATONIC DIVISION OF CONNECTICUT POWER COMPANY

Village and Bristol, which is about 40 miles, the 66,000-volt system consists of two three-phase circuits carried by double-circuit steel towers on a right-of-way 100 ft. wide. The circuits are arranged vertically on opposite sides of the tower 12 ft. apart with the middle conductors offset 3 ft. from the plane of the other two wires. This arrangement was considered advisable as wires in the same plane might come in contact due to sleet melting off them at different rates. The cross-arms are 8 ft. apart. Telephone wires are carried 9 ft. below the lower power conductors and transposed at every other tower. Along the apices of the towers runs a 5/16-in. galvanized-steel ground wire. The power conductors are No. 2 B & S gage copper, while the telephone wires are No. 6 B & S copper-clad steel.

The line was designed for 0.5 in. of ice on all conductors and ground wire and a wind pressure of 6 lb. per square foot occurring simultaneously at 0 deg. Fahr. Suspension towers are designed to withstand the pull of two conductors broken under this condition in the same span and on the same side of the tower in addition to a wind load of 22.5 lb. per square foot on two tower faces. Anchor towers are designed to withstand the breakage of all conductors and the ground wire in one span under the loading mentioned in addition to a wind pressure of 22.5 lb. per square foot on two tower faces. Lateral pulls at all conductor and ground-wire supports equal to the maximum tension obtained in each under extreme loading must also be withstood in addition to the wind load at all angle towers.

Both the suspension and anchor towers have 13 ft. by 13 ft. bases, the height to the bottom crossarm being 37 ft. for suspension towers and 34 ft. for anchor towers. Structural-steel pyramid-shaped foundations set 6 ft. in the ground are used in good soil. On ledges anchor bolts are grouted in the rock, while in swamps special anchorage is employed. Suspension insulators of the Pittsburgh and Locke types are used, five 10-in. disks being employed at suspension points and six disks at dead-ends. Anchor towers are located at angles and approximately every mile on tangent lines. The average spacing of towers is 430 ft., although spans as small as 200 ft. and as large as 1000 ft. are employed. Telephone booths are provided in the tower bases approximately every 4 miles.

From Bristol to Berlin, a distance of about 13.5

miles, somewhat higher towers with larger bases are used but are designed for the same loading as those on the Falls Village-Bristol line. This section carries only a single circuit. As mentioned in the first part of the article this line will be extended to Cromwell where, step-down connections will be made with the Middletown steam station of The Connecticut Power Company.

The Bristol-Berlin single-circuit line continues to Hartford on wood poles while a similar wood-pole line connects New Britain with the steel-tower line. Forty and 45-ft. chestnut poles spaced 180 ft. apart are used on these lines. They carry two 5-in. by 6-in. cross-arms, the lower being 8 ft. 8 in. long and carrying only one conductor, and the upper being 10 ft. long and supporting two conductors. A 5/16-in. ground wire runs along the tops of the poles and telephone conductors are supported below the power conductors.

Dead ends are provided at frequent intervals, the poles being head guyed in two directions at such points. Four 10-in. suspension insulators are used at suspension points and five disks at dead ends.

In connecting the system to that of The Hartford Electric Light Company, it was necessary in order to provide for exchange of power between the two systems in either direction, to install an induction regulator in series with the 11,000-volt tie-lines. This regulator has a 10 per cent range and can be set to "buck" or "boost" as desired, depending on the direction in which energy is sent. In addition, the low-tension winding of the 66,000/11,000-volt transformer is provided with taps for 11,000 to 12,500 volts.

Most of the energy is sold to the Torrington Electric Light Company, the Bristol and Plainville Tramway Company and to the Hartford Electric Light Company. For the period July to December, 1914, 1,907,170 kw-hr. were generated; from January to December, 1915, 11,623,514 kw.-hr. and from January to September, 1916, 23,898,675 kw.-hr. Demands for electricity are increasing rapidly, particularly in Bristol, where the New Departure Manufacturing Company, a subsidiary of the General Motors Company, is increasing its plant extensively. The Bristol Brass Company is also increasing its capacity in the same way. The industries throughout this territory are very stable, most of them having no direct connection with the present, so-called war business.

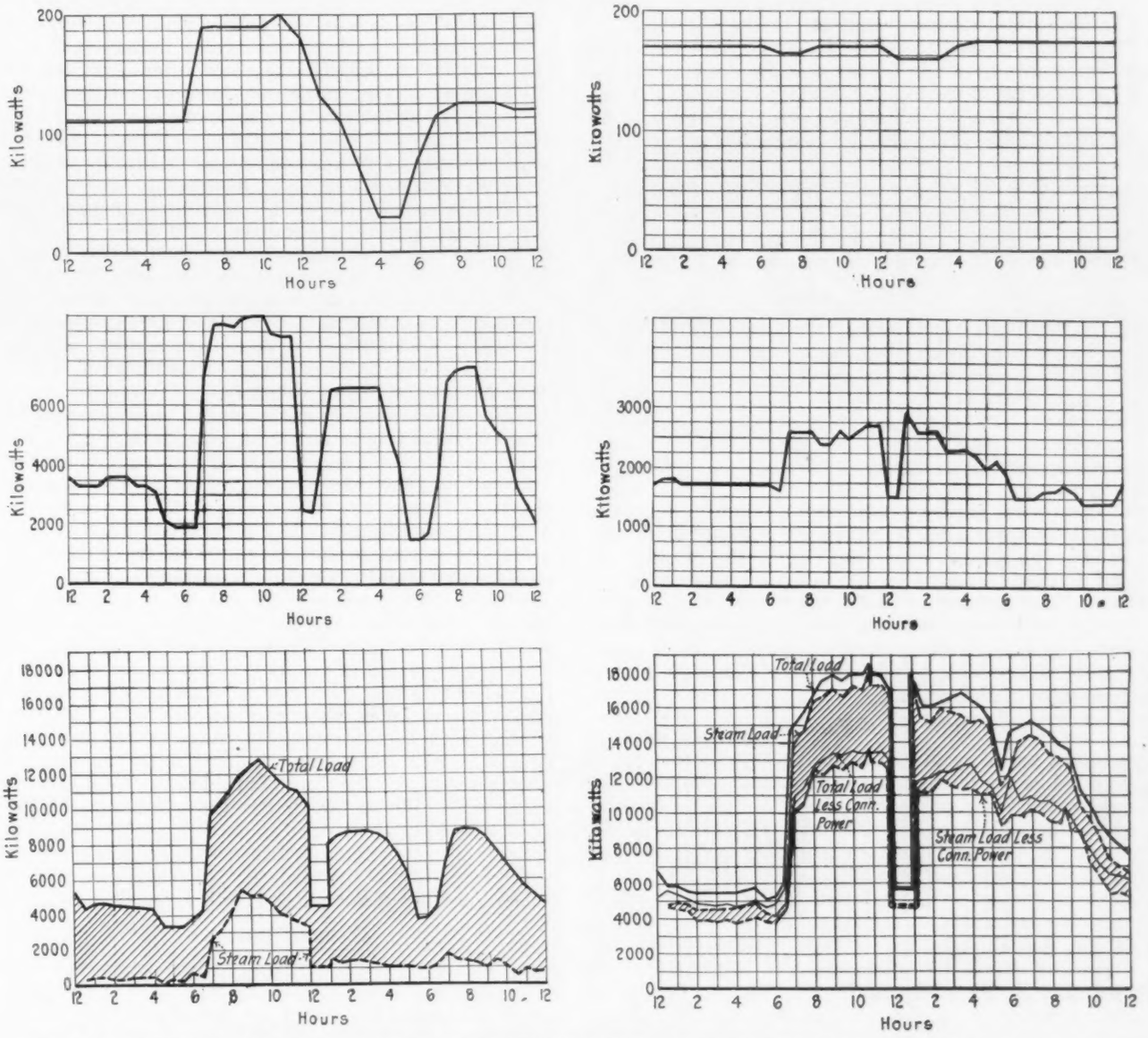


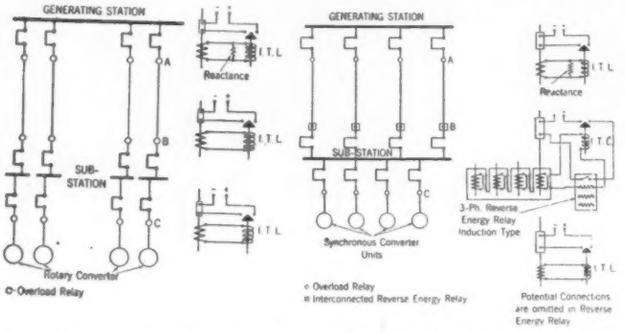
FIG. 2—PROPORTIONS OF TOTAL LOADS CARRIED BY WATER AND STEAM PLANTS ON TYPICAL DAYS OF WET AND DRY SEASONS

The left-hand set of curves indicate conditions on May 6, 1916, and the right-hand set on Sept. 26. The top row of curves represent the loads carried by the Canaan plant, the next lower row the loads carried by the Falls Village water power plant and the lower row the load of the Hartford plant. On May 6 the Connecticut Power Company delivered 73,000 kw.-hr. to the Hartford company, while on Sept. 26 conditions were reversed with the Hartford Electric Company supplying 60,000 kw.-hrs.

Relay Practice of Large Systems

Types, Arrangement and Settings of Instruments Used for the Protection of Distribution Networks, with an Account of the Discussion at the Chicago Meeting of the A.I.E.E.

TWO papers on relay protection were presented at the Chicago meeting of the American Institute of Electrical Engineers on March 9: one by Philip Torchio, chief electrical engineer of the New York Edison Company, and the other by R. F. Schuchardt, electrical engineer of the Commonwealth Edison Company. The first paper reviewed the most prominent systems of relay protection which are being employed in this country and pointed out the combinations which give



FIGS. 1 AND 2—RADIAL FEEDERS—NOT PARALLEL AND PARALLEL

the maximum degree of protection with a minimum expenditure, especially for conditions obtained on existing lines. The second paper dealt with the arrangement and setting of relays on one large interconnected system. Both authors pointed out that the function of the relay is no longer to protect apparatus against overloads but to disconnect any part of a system on which a fault occurs, and prevent extension of the disturbance to the remainder of the system.

NEW YORK PRACTICE

In the paper by Mr. Torchio it was pointed out that overload relays of the inverse-time-limit type have been used extensively and successfully in this country for protecting radial feeders not operated in parallel at the substation. Several large companies have furnished the additional protection of a selective-ground relay to indicate a ground on the affected feeder. From experience obtained with this combination, it appears, said the author, that this system warrants further applications. Protection of radial feeders operated in parallel at the substation is best secured by the use of (a) the reverse-power relay in combination with overload relays, and (b) the balanced or Merz-Price system. The split-conductor system is especially suitable for new installations or systems where existing duplicate overhead lines can be arranged to give a split-conductor circuit.

For single lines in tandem, extensive use has been made of definite and inverse-time-limit relays, set for progressively longer time intervals the nearer they are to the generating station. Where there are two or more parallel lines in tandem very satisfactory results have been obtained by connecting inverse-time limit relays at the point where energy leaves the station or substation and using overload relays in combination with reverse-power relays at the points where energy enters the substation. The balanced system, previously mentioned, is also especially adapted to such conditions.

While the balanced system might be preferable for new installations of single-line ring systems, very good results can be obtained by using reverse-energy relays in combination with inverse-time-limit relays set for progressively longer time intervals the nearer they are the generating station. Results will apparently be very satisfactory in parallel-line ring systems if inverse-time-limit relays are used in the outgoing feeders at the generating stations and if a balanced inter-connected combination of reverse-energy and inverse-time-limit relays is employed at the receiving ends of the supply feeders. When energy is furnished to several parts of a system, interconnected through several substations by duplicate feeders, overload relays can be used on the outgoing feeders at each of the main receiving stations to eliminate the possibility of a complete shut down.

Where energy can pass in either direction between generating stations through tie lines, the Merz-Price or balanced system of relays is probably most advantageous. Any one of the following arrangements can be used: Split-conductor principle; combined interconnected reverse-power and inverse-time-limit relay, or relays with the plungers mechanically interlocked.

Relay protection is seldom applied to generators, but when it is, it can be secured by connecting differential relays to current transformers in both ends of each individual winding and also by means of reverse-power relays in connection with overload relays having tripping contacts in series. If a ground is connected to the generator neutral or to the neutral of one or more generators operating in parallel, the selective relay ground principle can be employed for protecting generators by having a transformer of the relay system in series with the ground lead. Transformer protection has been best obtained by means of differential relays.

Since the power factor of a short-circuit may vary from zero to unity, the reverse-power relay should be capable of selecting through a range of 180 deg. Excellent results have been obtained with the selective ground relay by the New York Edison Company for nine years. Where the feeders are paralleled in a substation, a grounding relay is used in conjunction with the balanced interconnected reverse-energy relay on the substation ends of the feeders. All feeders leaving the substations are also equipped with grounding relays.

CHICAGO PRACTICE

An outline of the protective schemes employed by the Commonwealth Edison Company was given in the paper by Mr. Schuchardt. All of the newer generating units employed by this company and one of the old 20,000-kw. vertical units are equipped with balanced relays of the Merz-Price type. The other generators are not equipped with automatic relays at present. The generators, with their external reactors, when the latter are used, have reactances ranging from 7 to 12.5 per cent, depending on their ratings. The tie lines are protected with balanced relays, the connections being arranged so that the relays will operate only with a ground current. Tie lines between Fisk Street and Northwest station are about 8 miles long, therefore they are treated like ordinary lines. Uni-directional relays have been installed at each end to replace the bellows type and, in addition, an adjustable, definite-minimum, inverse-time-element relay will be installed to trip the 60-cycle switch in case of a sustained excessive overload. The uni-directional relays will be set to operate instantaneously on energy feeding inward and the inverse time-limit relays will be

set to trip in about three seconds with 10,000 kw. Bellows-type relays are also being rapidly replaced by induction-type adjustable, definite-minimum, inverse-time-element relays on the transmission lines leaving the generating stations. Where a line is a part of a ring and the time setting of the relay at the station end is more than one and one-half seconds, an additional relay of the same type is used but set to operate instantaneously. At the substation end of these lines as well as on the tie lines between substations are connected uni-directional inverse-time-element relays of the induction type, or balanced relays in some instances on rings.

Induction-type relays are used on all transmission lines except where their use requires too high a time setting, that is, one that exceeds two seconds. With ring-connected lines where consecutive relays in each link must have an increased time element, the nearer they are the station, the use of these relays would generally require more than a two-second setting, since the difference in time setting between any two consecutive relays in series must be equal to the time required for the oil switch to operate plus a safe margin, making the minimum time at least three-tenths of a second. To minimize the total number of relays connected in series in a ring of many links and thus prevent employing excessive time limits, the shortest sections in a ring are provided with balanced relays and pilot wires.

The bellows overload relays on the high-tension side of the substation units are set to operate in two seconds with three and one-half times rated current and instantaneously with five times rated current. Not more than 15 per cent overspeed is allowed in operating synchronous converters. Differential relays on the substation transformers and the relays on the 4000-volt feeders are of the instantaneous type.

Discussion on Relay Practice

Among those who participated in the discussion were H. R. Summerhayes, Schenectady, N. Y.; W. H. Cole, Boston, Mass.; E. B. Meyer, Newark, N. J.; L. N. Crichton, East Pittsburgh, Pa.; J. R. Craighead, Schenectady; O. C. Traver, Schenectady; A. A. Meyer, Detroit, Mich.; J. V. Taylor, Schenectady; H. L. Wallau, Cleveland, and J. S. Jenks, Pittsburgh.

Mr. Summerhayes pointed out that the papers presented indicate a tendency toward standardization of relay practice. He also expressed the belief that overload relays will make a system less selective for cable "shorts" than the system outlined in Mr. Schuchardt's paper, but the former will give better protection for a substation-bus short-circuit. Furthermore, he strongly recommended the use of balanced or differential relay protection for generators, and urged the installation of steam pipes for putting out fires and dampers for shutting off the draft.

Referring to the maximum time limits of 1.5 or two seconds mentioned in both papers, the speaker said that he had recently made calculations which show that for fifty times full-load current the temperature rise is at the rate of 55 deg. C. per second and for 100 times full-load current at the rate of 220 deg. C. per second. Since it takes a conductor several minutes to cool from a temperature of 220 deg. C. to the safe temperature of 100 deg. C., the effect is not merely momentary and the cable insulation may be permanently injured if the conductor rises to over 200 deg. C.

W. H. Cole said that the Edison Electric Illuminating Company of Boston had installed 60 miles of split-conductor cable protected by balanced relays. Part of the switch gear is English and part of it has been developed by the company's engineers. Experience to date indicates that the balanced type of protection is very satisfactory and that it permits extensions.

E. B. Meyer said that the Public Service Electric Company of New Jersey has installed about 7 miles of 350,000-circ. mil sector type, split-conductor cable on 13,200-volt circuits during the past year. During 1917 10 miles more will be installed.

At opposite ends of each split conductor are installed reactors which produce a reactance drop equal to 12 per cent of the resistance drop at rated current. With this arrangement the maximum voltage between "splits" during an end fault should not exceed 1000 volts. The cost of the cable is from 10 to 15 per cent higher than the ordinary type of cable and the cost of jointing is 25 per cent higher, but this additional expense appears warranted on important tie feeders. To be conservative the New Jersey company has rated split-conductor cables the same as solid-conductor cables.

Mr. Crichton called attention to the results of tests made several years ago which indicated that power should not be cut off from induction motors more than three seconds and then applied again, since the belts and clutches between the motor and the load could not stand the sudden increase in speed following the restoration of full voltage. Falling out of step is another limitation to the length of interruption of power which should be allowed.

A. A. Meyer of Detroit outlined a very simple scheme which the Detroit Edison Company has used successfully for more than a year, since it changed from a radial to a parallel system of operation. It was brought out later by Mr. Wallau that this scheme is particularly applicable where a number of feeders and substations lie between two power houses. He also said the Cleveland company, which operates its system in tandem with cables in parallel, had found sufficient protection by using overload relays at the sending end and reverse-energy relays at the receiving end.

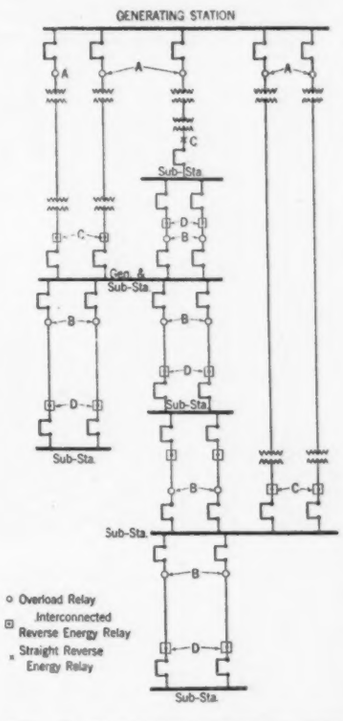


FIG. 3—PARALLEL FEEDERS—RING NETWORK

J. S. Jenks said that the West Penn Electric Company had estimated that with ordinary protective schemes the time for the operation of some of the relays would amount to as much as ten seconds. To avoid this delay a system has been devised in which all of the switch gear is normally locked closed. Should the voltage in any part of the system, however, fluctuate beyond pre-determined limits, the switches will be automatically unlocked so they become operative.

In closing the discussion Mr. Torchio expressed the opinion that large generators should be protected. Mr. Schuchardt remarked that the disadvantages of the balanced system are its complications, its high cost and the fact that it adds another element to the system. In line with Mr. Summerhaye's remarks, he said that one and a half seconds is as long as he should advise that a short-circuit be left on the line.

Motor Drives in a Screw and Bolt Plant

Convenient Arrangements of 184 Induction Motor Drives Which Represent an Average Load of 170,000 Kw.-Hr. per Month with a Monthly Load Factor of 30 per Cent and a Demand Factor of 45.5 per Cent

By L. J. Lamberger
Member of engineering staff, Duquesne Light Company

THE many advantages claimed for electric motor drives in various industries have likewise been realized in the screw and bolt plants. The machines used in the manufacture of this product consist principally of lathes, threading and tapping machines, punches, shears, hot and cold heading machines, blowers and power hammers. The flexibility obtained by a motor drive has proven advantageous since the machinery is located where it is easily accessible and the material can be quickly taken to and from the machine in the course of manufacture. Each machine or group of machines can be operated independently and the starting and stopping of one or another does not necessarily affect the others. Among the various other practical considerations involved in the operation of a plant of this kind is the human factor. It is generally agreed that the working conditions of the employee is of great importance and worthy of careful attention. The motor has also been found to have advantages in this respect.

The factory layout and operation at the plant of the Pittsburgh Screw & Bolt Company at Pittsburgh, Pa., from the standpoints of completeness of working equipment, power equipment and means of providing for employees first-class working conditions are of interest and described in what follows.

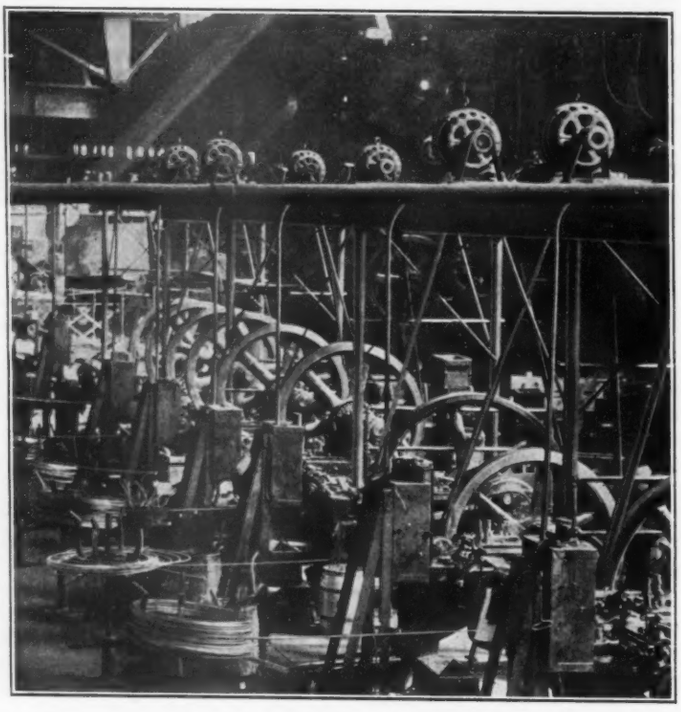


FIG. 1—SMALL COLD-HEADING MACHINES DRIVEN BY INDUCTION MOTORS MOUNTED OVERHEAD

For a number of years before this company moved to its present quarters, the old plant was driven by means of engines through a series of line shafts and belts. A part of the plant was, however, electrified, and it proved so successful that when the equipment was moved to its larger quarters, the old method of developing and transmitting power was entirely abolished and the modern, more efficient and flexible drive by motors was adopted. The capacity of this plant in the manufacture of bolts, nuts, screws, tie rods and rivets is about 8000 tons a month. The building, a one-story rectangular-shaped structure of steel and brick, with concrete floors, is about 400 ft. wide and 800 ft. long. Raw material is brought into the plant on a railroad siding extending along one side of the building for almost the entire length and is unloaded and distributed by means of electric traveling cranes from this point to the machines where it is to be used. The finished product leaves at the opposite side of the building, where it is loaded into auto trucks and railroad cars for shipment. Each operation or each class of work is confined to a certain section of the building. Under normal conditions the plant operates ten hours per day, excepting Saturdays, when it operates alternately five and eight hours. All machinery is electrically driven and all energy for light and power is purchased from the Duquesne Light Company.

The substation has an ideal location in the center of the plant. Three-phase, 60-cycle service is supplied through cables at a potential of 11,000 volts. For distribution to the motors, this is stepped down to 440 volts by means of three 375-kva., 11,000/440-volt, 60-cycle, single-phase oil-cooled transformers, which are delta connected. For lighting, the voltage is stepped down to 110 and 220 volts by means of a 100-kva. transformer. The substation equipment also includes a motor-generator set consisting of a 150-hp., 440-volt, three-phase, 60-cycle, 900-r.p.m. induction motor direct connected to a 100-kw., 240-volt, compound-wound, interpole direct-current generator which supplies current to cranes, elevators, deep-well pumps and Cooper-Hewitt quartz lamps. The switchboard consists of four alternating-current power panels bearing an integrating wattmeter and a curve-drawing wattmeter, two lighting panels with an integrating wattmeter, and two direct-current panels with an indicating ammeter and voltmeter, making a total of eight panels. All power and light circuits are protected by circuit breakers mounted on the switchboard.

In all 184 motors are used, ranging in size from 2 to 150 hp., with an aggregate rated capacity of 2322.5 hp. Of this number 174 are 440-volt, three-phase, 60-cycle induction motors, including the motor of the motor-generator set, nearly all of which are of the squirrel-cage type. The total rated capacity of these, which is the total connected power load on the alternating-current supply, is 2197.5 hp. The remaining ten are 220-volt, direct-current motors, the energy for which is supplied from the motor-generator set. Both the individual and the group drives are used, the former, however, being employed more extensively. Unless the motor is direct connected or geared to the machine driven, it is usually mounted overhead. In this way very little floor space is utilized for power purposes. All power

feeders are run in conduit underground. Switches are inclosed in metal boxes and carefully placed where most convenient to the machine operator.

In Fig. 4 is shown a group of three heavy cold-heading machines, each driven by a 20-hp. motor. This view was taken from the rear of the machines to show the relative position of the motors. The switch and

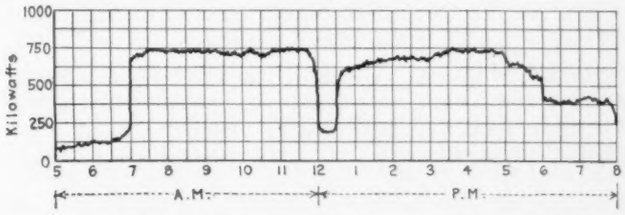


FIG. 2—AVERAGE DAILY POWER LOAD OF MOTORS INSTALLED

starter controlling the motor are located in front of the machine near the operator. These machines will produce bolts or rivets, 5/8 in. to 1 in. in diameter, from cold stock at an average rate of forty-five per minute. Raw material, in the form of wire, is automatically fed to the machines from reels. In passing through it is headed and cut into desired lengths in one operation. The finished bolt or rivet drops through a chute into a keg. When the keg has been filled and its contents weighed, it is put on an electrically driven conveyor and carried to another department for additional machine work or to the shipping department.

In Fig. 1 is shown a group of eight smaller cold-heading bolt and rivet machines, each belt driven by a squirrel-cage induction motor, mounted above on a steel frame support, where it occupies no valuable floor space and the belt neither interferes with the free handling of materials nor endangers employees passing about the machines. The switches controlling these motors are inclosed in metal boxes mounted on brackets of angle iron. The operation of these machines is similar to that of the machines shown in Fig. 3, except that the rivets and bolts made are of a smaller size and the number produced in a given time is somewhat greater. The larger sizes of bolts and rivets are preheated in furnaces and forged in so-called hot-heading machines.

TABLE I—ENERGY CONSUMPTION FOR PLANT COVERING A PERIOD OF SIX MONTHS

Month	Light, kw.-hr.	Power, kw.-hr.	Total kw.-hr.
August, 1915	4,881	133,350	138,231
September, 1915	5,682	137,120	142,802
October, 1915	9,739	168,550	178,289
November, 1915	11,735	160,740	172,475
December, 1915	13,922	173,150	187,072
January, 1916	16,615	185,120	201,735
Average	10,429	159,672	170,101

The nut presses are driven by 7.5-hp. 1200-r.p.m. squirrel-cage motors mounted similarly to those in Fig. 1. The switch boxes and starters are located within convenient reach of the operators.

The curve of Fig. 2 is a typical power load under normal conditions. The maximum demand is 750 kw. The curve is a fairly smooth one, this being due to the fact that the entire load consists of comparatively small motors, the largest motor being only a small part of the entire load, so that the sudden starting and stopping of a motor causes but a slight variation in the load. Besides this some of the motors, such as blower motors, are a steady load. There is very little load between the hours of 8 p. m. and 5 a. m.

The plant is lighted through a large amount of window space on the sides and top of the building. On dark days, when light from this source is insufficient, and at night general illumination is obtained by means of thirty-six Cooper-Hewitt quartz lamps. At machines, in the office and other places where a more concentrated light is desired incandescent lamps are used. The larger of these are of the gas-filled tungsten type. All incandescent lamps are connected directly to the alternating-current supply. The maximum load from this source is 45 kw. A three-wire, 110-220-volt distribution system is used.

The increase in power consumption is due to increased production. The increase in consumption for light is due to both increase in production and the dark

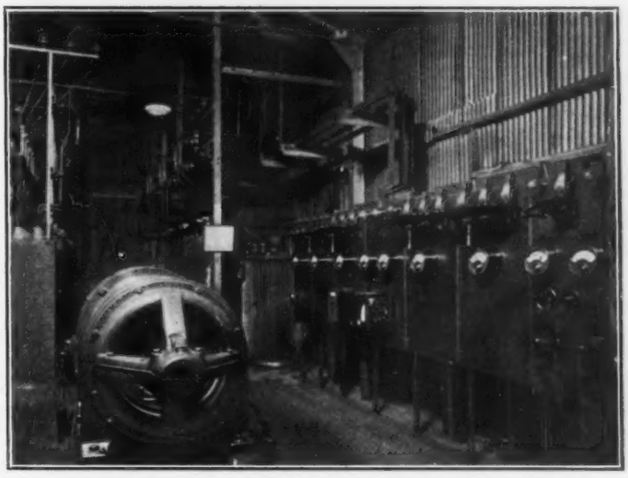


FIG. 3—SUBSTATION IN SCREW AND BOLT FACTORY

days of the winter season. Taking the maximum demand on light and power as 795 kw., the load factor, based on the average energy consumption as shown above and 720 hours per month, is 29.7 per cent. During the month of January, 1916, the output was close to 5000 tons. This number divided into the total number of kilowatt-hours for the month shows an energy consumption of 40 kw.-hr. per ton of product. The average power consumption per month per horsepower of connected load for the six months was 72.6 kw.-hr. The demand factor or the ratio of the maximum demand to the total connected power load is 45.5 per cent.

A complete record is kept of the performance of each

FIG. 4—COLD-HEADING MACHINES GEARED TO MOTORS BELOW

motor. When a motor is repaired, the date and extent of such repairs are carefully recorded in a systematic way. These records are gone over regularly, and in this way the electrician knows when a motor is due for an inspection. With this method in use, very little inconvenience due to motor trouble is experienced. A similar plant is operated by this company at Gary, Ind.

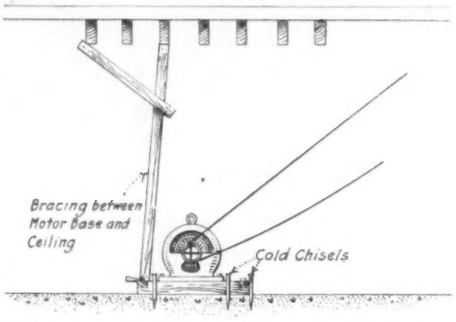
STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Temporary Installation of Motors on Concrete Floors

BY H. S. RICH

To install a motor temporarily on a concrete floor where no secure anchorage is available the writer has found the following method effective and easy to follow: A square frame is bolted together for the motor to set



METHOD OF INSTALLING MOTOR TEMPORARILY ON A CONCRETE FLOOR

on, and in place of driving spikes through it into the concrete floor two or three cold chisels are driven in with a sledge along the side of the frame nearest the apparatus operated by the motor. Between the other side of the wooden frame and the ceiling are wedged two 2-in. by 4-in. posts. These posts are nailed, wedged and braced as shown. The posts hold the motor down and the chisels prevent it from twisting out of line. The motor is attached to the frame with lag screws.

SYSTEM MAP AND CARD FILES

How a Wall Map of a Distribution System Is Used in Conjunction with Transformer Records in Securing Line Information

On a wall space that measures about 12 ft. square the Indiana & Michigan Electric Company at Elkhart, Ind., has placed a complete map of the electric system in its city, the territory represented being about 2 miles

LOCATION NO. 430 — LOCATION: Penn – 1626 Franklin St West — CIRCUIT NO. 4

TRANSFORMER RECORD				TRANSFORMER RECORD				TRANSFORMER RECORD			
PLACED	OUR NO	SIZE K.W.	REMOVED	PLACED	OUR NO	SIZE K.W.	REMOVED	PLACED	OUR NO	SIZE K.W.	REMOVED
5 6 16	10	5									

METER RECORD				CUSTOMER	CONNECTED LOAD				
PLACED	OUR NO	SIZE AMPS	REMOVED	NAME AND ADDRESS	ARC LAMPS	CLUSTER LAMPS	INCAND. LAMPS	K.W. MOTORS	TOTAL WATTS	MOTORS NO. H.P.
5 31 16				John Ray – 1716 Riggs St			16			1 ½
			6 8 17	Henry W. White 1101 Pratt St			10			
				C.W. Jones – 1211 Franklin St			15			

FIG. 1—HISTORY OF TRANSFORMER, METER RECORD AND CONNECTED LOAD

square. From this map and the card record systems used with it, it is possible to obtain practically all information required regarding lines and their equipment. Every primary circuit from the power house to its terminus is shown along the streets and alleys it traverses by a colored string. These strings are held in place by wood screws with special heads, like the one shown herewith. Strings held in this manner rather than painted or inked lines were used, since their locations can be easily changed if necessary. Although the string holders look like miniature poles with crossarms on them, they do not mark pole locations. Records of the

RECORD OF TESTS

DATE OF TEST	CORE LOSS: IMPRESSED VOLTS	CORE LOSS: EXCITING CURRENT AMPS	CORE LOSS: WATTS LOSS	POLARITY TEST	RATIO TEST	W O NO	COST OF TEST: MATERIAL	COST OF TEST: LABOR	COST OF TEST: EXP.	COST OF TEST: TOTAL

RECORD OF REPAIRS

DATE ORDERED REPAIRED	DATE RETURNED	REPAIRED BY	OUR PURCHASE ORDER NO.	COST OF REPAIRS: MATERIAL	COST OF REPAIRS: LABOR	COST OF REPAIRS: EXP.	COST OF REPAIRS: TOTAL

FIG. 2—RESULTS OF TRANSFORMER TESTS AND COSTS OF REPAIRS ENTERED ON THIS CARD

poles are kept in a book containing maps of the different sections of the city drawn to a much larger scale than the wall map. The locations of all streets and alleys, transformer banks and street lamps, however, are marked on the wall map.

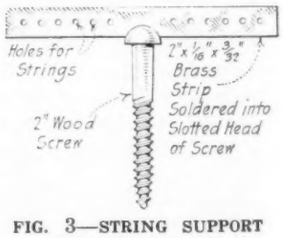


FIG. 3—STRING SUPPORT FOR USE ON MAP

According to representatives of the Elkhart company, not a day goes by but what the map is consulted. It is used to provide information on line extensions, trouble calls, street-lamp locations and sizes, transformer locations (the load conditions of which are kept on indexed cards). and on three-phase power-circuit locations. As an aid to the contract department it is also of value. Moreover, it possesses some advertising value, since it is visible from a large window on the street. People passing stop to look at it, and customers in the office often consult it for general information.

For more detailed information than the map gives the card records previously referred to may be consulted. Each transformer shown on the map bears a

OUR NO. 10 — TRANSFORMER CARD — CONDEMNED 19 — SCRAP VALUE

PURCHASE RECORD

OUR ORDER NO.	DATE	MFG. INV. NO	DATE	PURCHASE PRICE	F.O.T.	CARTAGE	TOTAL COST

DESCRIPTION OF TRANSFORMER

MAKE	SIZE K W	TYPE	VOLTS	SERIAL NO	STYLE NO
Westinghouse	5	OD	400	34567	2369

DATE PLACED	W. O. NO.	PLACED ON POLE NO	LOCATION NO	LOCATION	DATE REMOVED	W O NO
5 6 16	21942	14-361	430			

FIG. 4—DESCRIPTION OF TRANSFORMER AND RECORD OF PURCHASING INFORMATION

number. Corresponding to this number in a convenient file are 4-in. by 6-in. cards, which give the entire history and rating of the unit and also its location number. Knowing the latter anyone can learn where the unit is situated, when it was set, what circuit it is on, what its rating is and what load it is carrying by referring to a set of 5-in. by 8-in. cards numbered to correspond. This map and record system, which cost originally about $400, is said to be worth that amount as a time-saver alone.

TWO-PHASE MOTOR TROUBLE

How Trouble Due to Starter Connections Was Corrected by the "Cut and Try" Method

BY HENRY MULFORD

Owing to indistinct lines and erasures on a manufacturer's wiring diagram the writer had to try several two-phase motor connections shown in the accompanying illustration before arriving at the proper connections shown by the solid lines. At first the connections

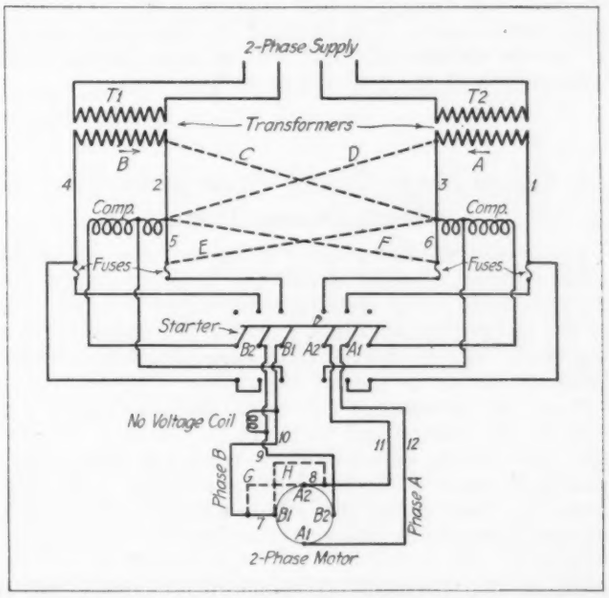


FIG. 1—STARTER CONNECTIONS WHICH CAUSED MOTOR TROUBLE

on the supply side of the compensator were made as shown by lines 1 and 4, and dotted lines *C* and *D*, lines 2 and 3 being disconnected. With the remaining connections made as shown by full lines and the compensator switch in the starting position this crossing of wires placed the transformer secondaries and entire compensator windings in series besides connecting each motor phase across a portion of a compensator winding. When the switch was placed in the running position the transformer secondaries, alternate compensators and motor windings were placed in series. Since these connections did not permit operation, the connections of motor leads 7 and 8 were transposed, as shown by dotted lines *G* and *H*. This change permitted starting the motor and operating with the switch in running position, and might have been accepted as the solution to the problem if the no-voltage release coil had not failed to magnetize when the switch was in the starting position. As shown, the coil was across leads 9 and 10.

An attempt was made to correct this trouble by disconnecting wires 5 and 6 and reconnecting as shown by lines *E* and *F*. This gave full potential across the trip coil with the switch in running position. With these connections, however, a peculiar condition existed. The motor started, but when the switch was thrown to the running position the motor phases were connected in series and the machine operated as a single-phase unit running on the resultant field produced by the motor coils. This condition would not have been noticed if heating had not occurred at a load which was within the rating of the motor. To remedy this trouble

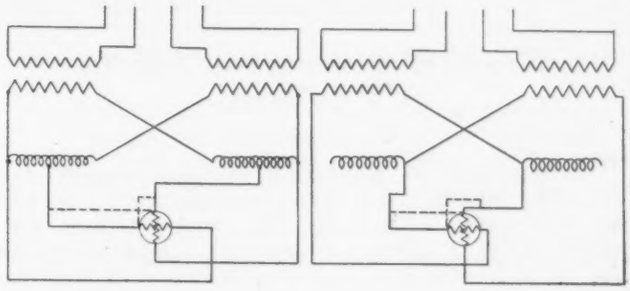


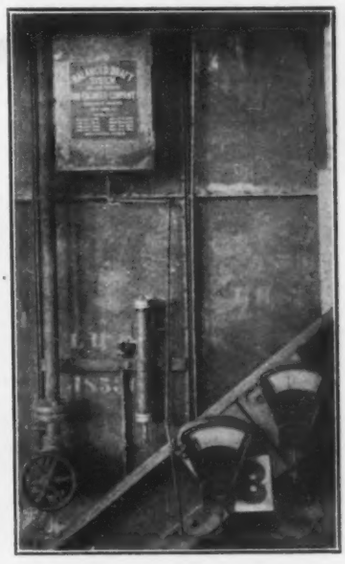
FIG. 2—CONNECTIONS EXISTING WHEN STARTING AND RUNNING

the wiring diagram was more closely examined by means of a magnifying glass which showed the connections indicated by continuous lines. After these were made starting, running and operating with rated load were permitted without any objectionable conditions arising.

This experience indicates the need of "making haste slowly" when connecting machines according to maker's diagrams, for seldom are mistakes made in them.

Maintaining Constant Draft Over Furnaces in Buffalo Plant

Provisions have been made at the new steam plant of the Buffalo General Electric Company for automatically maintaining a constant draft over its furnaces. The particular draft selected was found by trial with each boiler, the governing factor being that it should permit the most efficient results at all rates of combustion. To prevent possible "flare backs" from momentary furnace pressure, the draft is usually maintained at about 0.05 in. of water. As a result of the furnace conditions thus maintained a variable rate of combustion is obtained economically and quick response to sudden changes in load is secured without dampers. In addition widely different grades of fuel may be utilized, uniform steam pressure may be maintained and the life of the boiler and its setting prolonged.



APPARATUS FOR MAINTAINING CONSTANT FURNACE DRAFT

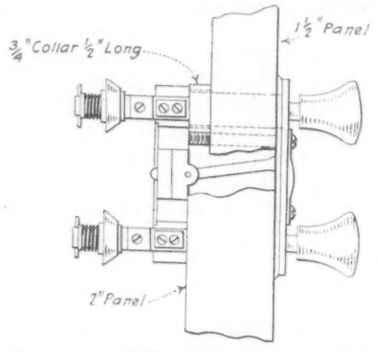
The apparatus consists of a draft regulator furnished by the Engineer Company of New York City, the forced draft being controlled by the steam pressure varying the fan speed. This draft is maintained constant by the adjustment of a damper in the smoke connection from the boiler. The damper is operated by 30-lb. water pressure through the medium of a hydraulic cylinder and a system of levers. Built in one side wall of the boiler setting is a large iron pipe across which is a

movable vane, held in a definite position by a weight. Since one side of the vane is subjected to furnace pressure and the other side to atmospheric pressure, change in the draft condition over the fuel bed will change the location of the vane and operate the pilot valve controlling the hydraulic cylinder previously mentioned.

Method of Adapting Pull Switch to Thin Panel

BY F. O. WOODWARD

Certain types of pull-button switches intended for mounting on 2-in. panels are unsuitable for use on 1.5-in. panels. Since the latter size panel is coming into extensive use, it is therefore necessary to make allowance for the difference in thickness of panels when the 2-in.



TWO-IN. PULL SWITCH MODIFIED FOR USE ON 1.5-IN. PANELS

switch is used on a 1.5-in. panel. It is possible to shorten the shanks of the pull rods, but this necessitates turning the rods in a lathe, shortening springs, etc., and is therefore a rather expensive process. This modification also unfits the switch for future mounting on 2-in. panels if it should be desirable to do so. A very convenient and effective method of overcoming the difficulty is to cut (preferably in a lathe) 0.5-in. collars from 0.75-in. steel conduit, thus requiring no boring. The collar is then slipped over the pull rod in the position shown herewith, thereby making a solid mounting which does not occupy much space and will maintain its place. There is no opportunity for shrinkage with consequent loss of alignment that sometimes results with a fiber spacer. The switch to which the modification applies is a General Electric, catalog No. 62557.

Operating Company Prefers Wood Boxes for City Construction Crews

After experimenting with steel boxes for tools and material a central station company operating in a large Middle Western city has decided that they are not as good as wooden boxes. The steel boxes which were used were made of heavy sheet metal and were fairly well reinforced. Reinforced oak boxes weighing 24 lb. each are now being used.

Besides being 7 lb. lighter in weight the wooden-type construction box has other advantages over the steel box. First, it costs only about one-half as much to build; second, it does not rust; third, it is not a conductor of electricity and can be used sometimes as an insulating stand. With the steel box it was found that a rope attached to the handle could not be used for lowering the box into a manhole; the weight of the box and the material in it sprung the end out so that the lid did not fit. With wooden boxes this trouble does not occur.

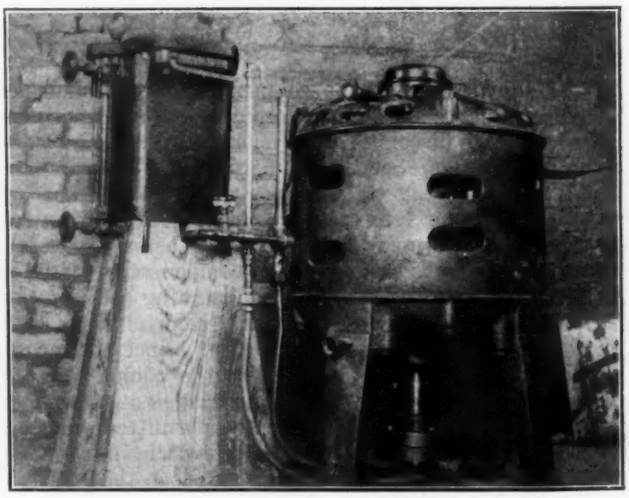
Protection for Padlocks Used on Outdoor Meter and Switch Houses

It is a common practice to equip the gates to outdoor substations, doors of meter houses, transformer vaults and kiosks, switching houses and the like with padlocks in preference to other types of locks, probably because they are more accessible under all circumstances, and especially when a key is missing they can then be easily cut. Padlocks used in this class of work are exposed to the elements—rain and dampness—often directly but in any case indirectly, and under the influence of the weather soon corrode and rust, making them difficult to manipulate and often requiring strenuous efforts which result in a damaged lock.

To overcome this it has been found worth while, where padlocks are subjected to outdoor conditions, to wrap the lock with several layers of friction tape. This will very largely prevent water trickling into the mechanism or condensing therein. A little oil or kerosene poured into the lock before applying the friction tape will also prove beneficial. This practice even on locks made of so-called moisture-resisting materials will save much time and annoyance in opening padlocks that have to be opened sporadically, and will in many instances extend the life of the padlocks as well.

A Home-Made Oiling Arrangement for a Motor-Driven Pump

In an accompanying illustration is shown a home-made automatic oiling device for a motor-driven centrifugal water-pump installation operated from the lines of the Osage County Light & Power Company of Lyndon, Kan. An old transformer case mounted as shown herewith serves as the oil reservoir. Two lengths of 0.25-in. tubing connect this with the bearings of the 3-in. Morris centrifugal pump 14 ft. below in the well pit. The needle valves leading from the transformer case were made of cream separator parts. The lever operating these valves above is prevented from grounding the meter by a piece of fiber board 4 in. long at-



OILING ARRANGEMENT FOR MOTOR AND PUMP IT OPERATES MADE FROM TRANSFORMER CASE

tached to the end of the lever. When the motor starts this lever is raised, thus allowing the oil to flow. The transformer case holds sufficient oil for three weeks' supply. The motor is started at the power house 0.5 mile away, so that it is not necessary to make a trip to the pump house until time to replenish the supply of oil.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

COMPRESSING COTTON BALES BY ELECTRIC POWER

Results of a Test on the Electrically-Driven Hydraulic Compress of the Alabama Warehouse Company of Attalla, Ala.

Cotton is compressed into 500-lb. bales at an average cost of 8 cents per bale in the electrically-driven hydraulic cotton press installed for the North Alabama Warehouse & Compress Company of Attalla, Ala.

A recent electrical test of this equipment was made by inserting standard portable meters in the incoming power circuit to the motor to read the kilowatt input and power factor.

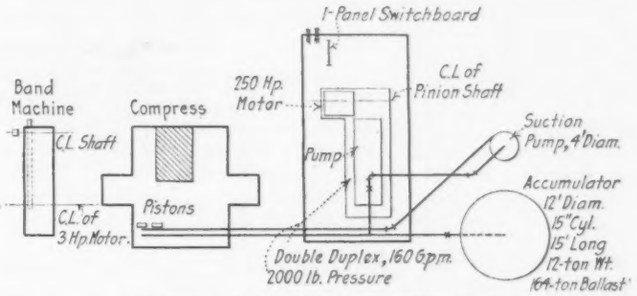
The accompanying diagram shows the layout of the compress, pump, accumulator and motors. The motive power is supplied by a 250-hp., 500-r.p.m., 220-volt alternating-current slip-ring motor. This motor is geared to a duplex double-acting pump of 160-gal. per minute capacity with a working pressure of 2000 lb. per square inch. The water is first pumped into an accumulator, from which it is supplied directly to the hydraulic press. The accumulator is loaded with scrap iron weighing 176 tons. Readings were taken once a minute during the test and the curves show the readings as charted. The maximum load noted on motor was 182.4 kw. and the average no-load reading was 14.4 kw.

The average load during the test of 100 minutes was 155 kw. The power factor on the motor ranged from 16 per cent at no load to 87 per cent at the maximum load. The energy consumed during the test was 260 kw.-hr., including an idle period of twenty minutes in which part of the time the motor was running at no load and the balance of the time the compress cylinders were being operated for demonstration purposes.

During the electrical test on the motor the different operations of the press were carefully noted and timed to secure the average time required for the actual compressing of a bale. Observation shows that six distinct operations were required at the press, the average time being:

1. Putting bale in press (by hand), five seconds.
2. Closing doors of press (by hand), three seconds.
3. Side and end compression (power), nine seconds.
4. Vertical compression (power), eight seconds.
5. Tying bale (by hand), fifteen seconds.
6. Taking bale out of press (by hand), five seconds.

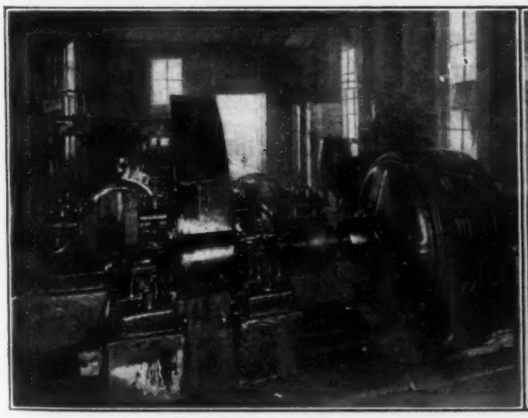
This makes a total of forty-five seconds for the actual compression process. During the test of 100 minutes 100 bales of cotton were pressed, or sixty bales per hour, but as about twenty minutes of the period was required to take photographs of the different stages of compression and in demonstrating the compress, the actual working time was only eighty minutes, and the bales were actually pressed at the rate of seventy-five bales per hour.



LAYOUT OF COMPRESSOR APPARATUS

Of the 260 kw.-hr. used during the test, 245 kw.-hr. were used for the actual operation of the compress, or 2.45 kw.-hr. per bale compressed.

Figuring the energy at 2 cents per kw.-hr., the cost for energy per bale compressed would be 4.9 cents, or 5 cents approximately.



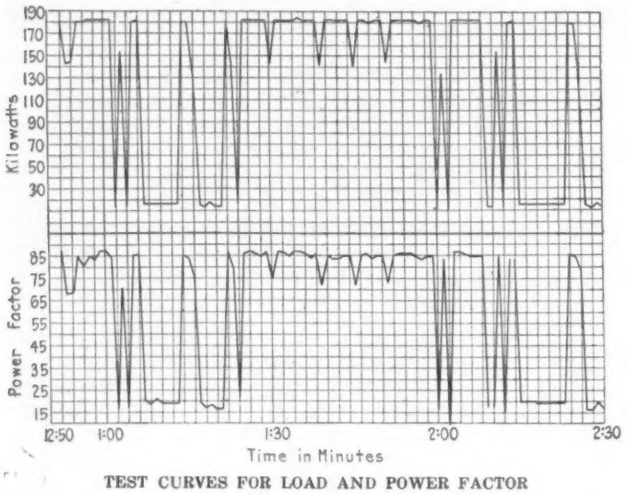
MOTOR-DRIVEN DOUBLE DUPLEX COMPRESSOR PUMP

COTTON COMPRESS, SHOWING BALE OF COTTON AT END OF COMPRESSION

The average size of a plantation bale is 27 in. wide, 48 in. thick and 54 in. long. The weight being 500 lb. gives a density of 12 lb. to the cubic foot. Owing to their large size and irregular shape it is only possible to load nineteen of these bales to the average box car. When it is considered that the minimum freight must be paid on a car regardless of weight, the mere shipping of the plantation bale becomes an expensive mat-

ter. A large area of valuable storage space is also occupied, as these bales must either be stacked and held in place by wood bracing or each bale allowed to occupy its own floor space.

The average size of an electrically compressed bale is 24 in. wide, 21 in. thick and 54 in. long. The compression of these bales to such a small size is an important factor in shipping, as each bale will only occupy



TEST CURVES FOR LOAD AND POWER FACTOR

40 per cent of the space required by an ordinary bale and the average box car will then easily accommodate 100 bales. While not compressed to as high an initial density as would be the case with the old steam compress, yet it actually makes a smaller bale, and the size being absolutely uniform permits stacking in cars in regular tiers, does not require bracing, as is the case with irregularly compressed bales, and does not require the handling or moving of bales for checking shipments.

Seven men are required for the operation of the compress. These men are paid at the rate of $1.25 per day, and the total labor charge is, therefore, $8.75, or 1.5 cents per bale when compressing at the rate of sixty bales per hour or 600 bales per day.

Including power and labor, the average cost per bale compressed is 8.2 cents.

TOTAL LABOR COST FOR OPERATION OF COMPRESS

During the test, the following men were employed:

2	men wheeling bales to rack, at $1.25	$2.50
3	men untying bales, at $1.25	3.75
1	man wheeling to press, at $1.25	1.25
7	men operating press, at $1.25	8.75
3	men wheeling bales to car, at $1.25	3.75
3	men loading bales in car, at $1.25	3.75
1	man, general machine man, at $2	2.00
	Total	$25.75

At an average daily output of 600 bales, the above total cost of $25.75 represents a labor cost of approximately 4.3 cents per bale.

STANDARD OF LIGHTING IN TEXAS TOWNS RAISED

Texas Power & Light Company Employs Illuminating Engineer for This Purpose with Idea of Giving Customer What He Ought to Have

Few central-station companies operating in the smaller towns and cities have devoted much attention to supervising the lighting service obtained by their customers. In certain sections the resulting objectionable conditions are especially apparent, and although in some localities steps have been taken to correct the tendency to install bare lamps without regard to the illumination neded, there still exists a very broad field for intensive work along this line.

Recently the Texas Power & Light Company has employed a competent illuminating engineer to devote his entire time to raising the standard of illumination in the various towns and cities where the company operates electric properties. Although this man has been in the field only a short time, results are already apparent, and the public is receiving the idea with hearty approval. Primarily the idea is to give the customer what he ought to have. This is being done even though it decreases the actual wattage installed. In most cases, however, changes result in increased wattage, so that the company profits in this way, and also from the fact that the customer will be a satisfied booster.

SERVICE TO THE "LESS THAN MINIMUM" CONSUMER

A Plan in Effect in Southern California Devised to Encourage the Individual to Use All the Energy He Pays For

On the lines of every central station that has a minimum monthly charge there is a class of consumers by no means small in number to which there is an opportunity of furnishing a better service, at the same time adding to the income. This is the "less than minimum" consumer, the consumer who uses less than the minimum amount of energy per month. Any way by which this class of consumers can be made to use the full amount of energy paid for would undoubtedly be welcomed by managers for (1) by showing the customers how to use all they are paying for complainers are turned into boosters, and (2) since a large part of the less than minimum accounts occur during the summer months by increasing the use of energy in these months means an increased use throughout the year.

Such a plan is in effect in the communities served by the Southern Sierras Power Company, which has a monthly minimum charge of $1. Customers using less than the minimum have this fact called to their attention.

With each month's bill for the minimum amount there is now sent out a printed slip headed "Additional Service Without Expense," under which the following is printed in bold face type: "We note that during last month you did not use all of the energy to which you were entitled under your minimum charge. You might have used more lights, larger lamps, an iron or other convenient appliance, without additional expense. We like our customers to receive a full measure of service for a given sum and hope you will plan to utilize an additional quantity this month. Let us help you to improve your service."

A report from each local superintendent is turned in to the general agent each month, showing the number of these minimum consumption slips which have been sent out. For the last nine months of 1916 these reports from eleven towns came in as listed in the tabulation on page 517.

The general decrease of the "minimum consumers" which was noted after the plan had been in effect a few months is thought to be partly due to the natural increase in lighting requirements as the days shorten. A part of the increase, however, is believed to be the result of directing the consumers' attention to "getting his money's worth."

The fourth town on the list illustrates a tendency which local superintendents have reported, namely, that after a month in which the effect of the printed slips was very noticeable, there occurred a marked tendency in the opposite direction. That is, when acting on the suggestion of the company the consumers carried the idea too far and exceeded the minimum considerably, so that their monthly bills were larger than usual. This re-

sulted in a reaction so that in the following month an unusually large number of "minimum consumer" slips were required. A remedy that has been suggested for this is the use of a meter dial diagram on the printed slips, so that the consumer will be encouraged to check up the consumption of current from time to time during the month. In connection with the printed slips it is also the policy to send circulars describing socket appli-

NUMBER OF CONSUMERS USING LESS THAN MINIMUM CONSUMPTION EACH MONTH

Total Customers	April	May	June	July	August	September	October	November	December
7	2	2	4	...	...	4	...	...	...
128	...	...	...	42	38	31	36	27	25
1299	183	247	353	429	332	211	114	70	77
772	147	169	...	267	253	201	163	...	142
9	2	4	3	4	4	3	2	...	...
148	7	39	52	57	55	57	35	8	21
245	105	94	110	167	170	155	150	130	65
223	76	77	87	...	...	82	45	60	52
1076	451	561	566	556	578	490	275	325	263
1116	528	573	589	638	632	424	470	338	281
227	60	106	84	80	60	65	50	51	65

ances which the consumer would find useful and which he might still operate so long as the minimum charge is in effect. Inasmuch as the territory served by the company has been generally supplied with electric irons, care has been taken to feature other appliances, using percolators, vacuum cleaners, disk stoves, electric fans during the hot weather, etc. This work is under the direction of E. B. Criddle, general agent of the Southern Sierras Power Company, Riverside, Cal.

RANGE SALES, LIKE CHARITY, SHOULD BEGIN AT HOME

St. Louis Company Opens Comprehensive Electric Cooking Campaign, with Sales Effort Directed Toward Officers and Department Heads

An electrical dinner given by the electric range department of the Union Electric Light & Power Company on St. Valentine's day to the officers, heads of departments and their wives was the first gun in a comprehensive range campaign. The object of this campaign is to sell electric ranges, first, to the employees of the Union Electric Light & Power Company; second, to the employees of other electrical concerns in the city of St. Louis, and third, to the general public. In commenting upon this program, C. E. Michel, manager of the company's office sales department, said: "We are very much inclined to believe that, like charity and babyhood, real knowledge and real praise of the electric range should begin at home."

Proof that the first gun had a real "kick" to it is to be found in the fact that each department head of the company who was not already the possessor of an electric range signed a contract on the evening of the party. The name of Charles S. Ruffner, vice-president of the company, headed the list. There are now twenty-one electric ranges in use by the employees of the company and the real campaign among the company's workers had not started at the time this was written. Plans for it have been laid, however, and during the spring months active solicitation of each employee is to be undertaken.

FLOOD-LIGHTING IN DENVER'S THEATER DISTRICT

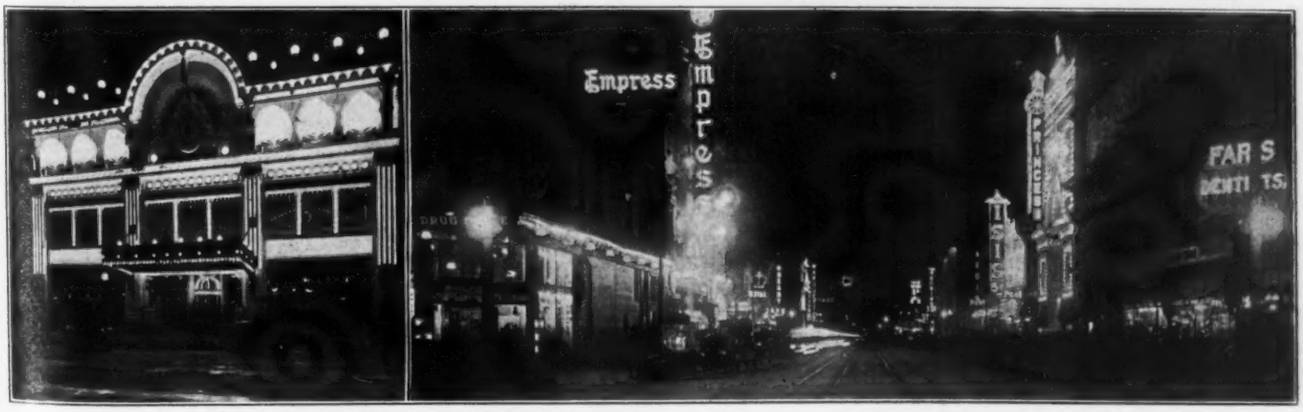
Motion Picture Houses, Restaurants and Other Buildings Have Adopted Brilliant Façade Illumination

That a better appearance may be obtained by flood-lighting building fronts than by using projecting signs has been appreciated by the proprietors of motion picture houses in Denver, Col. Most of the large movie theaters of that city are concentrated on Curtis Street, within two or three blocks in the heart of the business district, and their proprietors have taken up enthusiastically the idea of brilliantly illuminating the fronts of their various buildings. A visitor to Denver cannot fail to be considerably impressed by their efforts in this line.

This flood-lighting is not entirely confined to the motion picture houses. With three or four exceptions the three blocks on Curtis Street from Fifteenth to Eighteenth are solidly illuminated. Within these boundaries there are ten large movie houses and two large vaudeville houses. All of these places of amusement have adopted brilliant façade illumination. In the same three blocks there are half a dozen restaurants, two candy stores, and one or two penny arcades which are lighted in the same manner.

The lamps used vary in size from 15 to 500 watts, the rows on the actual fronts of the buildings of course being of small size, while the larger lamps are used mainly for high-power entrance lighting. The illumination of the Isis Theater is estimated to be 40,000 cp., the Rialto 50,000 cp., the Paris 35,000 cp., and so on proportionately for the others. The number of individual lamps used on this street for front illumination is stated by the power company to be 40,000.

The illumination lasts from dusk to midnight, an average of about six hours. The power company estimates the cost of this display illumination on Curtis Street to have cost $100,000 to install. Several theater owners are reported as having said that they would expect business to fall off 50 per cent if they were to return to ordinary lighting.



ON THE LEFT IS SHOWN THE BRILLIANTLY LIGHTED FAÇADE OF ONE OF THE THEATERS AND ON THE RIGHT IS A NIGHT VIEW OF ONE OF DENVER'S STREETS IN THE AMUSEMENT DISTRICT

ADVANCE IN TECHNICAL THEORY AND PRACTICE

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MEASURING FLUX DENSITY AND PERMEABILITY

The Use of a Differential Measuring System for Determining Flux Density and Permeability Up to Any Desired Density

A NEW method for determining the flux density, *i.e.*, the number of lines of magnetic induction per unit cross-section, up to any desired frequency is described by Prof. August Hund of the University of Southern California in the February issue of the *Proceedings* of the Institute of Radio Engineers. The same arrangement may also be conveniently used for obtaining the magnetic permeability and for investigating the total loss of a coil containing a ferro-magnetic core, or the core and copper losses separately.

The suggested arrangement is shown in Fig. 1, and

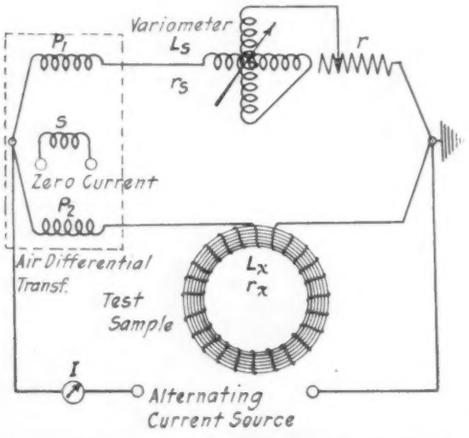


FIG. 1—APPARATUS FOR MEASURING FLUX DENSITY BY DIFFERENTIAL METHOD

is based on the application of a differential system, which was described by the author in the ELECTRICAL WORLD of May 22, 1915, page 1800.

One differential branch contains the test sample which has a definite coefficient of self-induction, L_x, for a particular current at a fixed frequency. The test sample is investigated by means of balancing its effect against a standard variable self-induction, L_s (variometer, air-core coils), in series with a non-inductive resistance, r.

The performance of such a differential system is briefly as follows: When the currents in the two branches of the system are equal in effective value and in phase, their inductive effects on the secondary coil of the differential transformer (shown to the left of Fig. 1) will exactly neutralize each other, and no voltage will be induced in the coil. This is based on the assumption that the two primary coils, P_1 and P_2, are symmetrically placed with reference to the secondary coil, S, and have exactly the same number of turns which are wound in opposite directions. Any kind of alternating-current detector connected across the terminals of the secondary coil will then give a no-current indication when the currents in P_1 and P_2 are equal and in phase.

A no-current adjustment is established when the coefficient of self-induction of the variometer is equal to the effective coefficient of self-induction of the test coil, and when the effective resistance of the test coil is exactly balanced by the resistance of the variometer and the series resistance r. An absolute disappearance of the differential field, however, can generally not be obtained since the wave form in the one branch is somewhat distorted due to the presence of the ferro-magnetic substance. In most practical cases, however, the minimum of the differential field can be very readily and accurately detected. For very precise measurements, it is advantageous to insert a condenser in series with the indicator in the secondary circuit of the differential transformer and tune this circuit to resonance with the required frequency. (This is especially recommended at higher frequencies since a tuning is then readily obtainable.) For frequencies up to about 2000 cycles, a Wien vibration galvanometer may be used as a current indicator, and the condenser may accordingly be dispensed with.

With this arrangement the maximum flux density is

$$B_{max} = 0.7075 \frac{L_s \text{ (henrys)}}{NS(Cm^2)} I \text{ (amp.)} \times 10^8$$

where L_s is the self-induction read on the variometer, I is the current measured by the ammeter in the main branch of the differential arrangement, N is the number of turns of the test sample, and S is the cross-sectional area of the iron core.

One way of exploring the magnetic properties of a ferro-magnetic substance by means of this method is to use a circular ring on which is uniformly wound a coil of wire of comparatively low resistance. The author shows that for a standard test ring of given cross-sectional area, length of magnetic path and number of turns, the maximum flux density, B_{max}, the maximum resultant field intensity, H_{max}, and the permeability μ can be calculated from observed data by means of the three following formulas:

$B_{max} = k_1 L_s$ (henry) I (amp.) lines of induction per square centimeter.

$$H_{max} = k_2 \frac{fL_s \text{ (henry) } I \text{ (amp.)}}{Z \text{ (ohms)}} \text{ gilberts per centimeter.}$$

$$\mu = k_3 \frac{Z \text{ (ohms)}}{f}$$

Where z is equivalent to the resistance operator of the test sample and the constants k_1, k_2 and k_3 of a definite dimensioned sample are given by the relations:

$$k_1 = \frac{0.7075 \times 10^8}{NS(cm)^2}$$

$$k_2 = 5.57 \frac{N}{l(cm)}$$

$$k_3 = 1.27 \frac{l(cm)}{N^2 S(cm)^2} 10^7$$

In these formulas N is the number of turns of the coil, S the cross-sectional area of the iron core, and l the mean length of the magnetic path.

Notes on the true magnetizing current and the determination of the iron losses follow and valuable practical hints are given on important details of the differential arrangement.

Generators, Motors and Transformers

Extra Copper Losses in Slot Windings.—R. RICHTER.—In previous articles the author has treated of the extra copper losses occurring in the windings of alternators through the uneven distribution of current over the section of the windings. He has shown how the eddy-current losses may be minimized by suitable arrangement of the conductors in the slot so as to insure that the copper losses shall be divided as evenly as possible between the various layers of the winding. The methods indicated fail in the case of bar windings with few or even one conductor per slot. In single-bar windings the alternating-current resistance of the whole winding decreases with the depth of the conductor in the slot, but not in proportion to the volume of copper required. For instance, a winding with bars of 6 cm. depth would give at 50 cycles per second copper losses inside the slot that are not less than the losses on direct current with bars of 1.1 cm. depth, and the copper losses in the whole winding would be equivalent to the losses in a direct-current winding with bars of 1.9 cm. depth, if half the total length of the winding were embedded in the slots. This shows that solid conductors may not be used with single-bar windings and deep slots. The present article is concerned with the mathematical discussion of the copper losses in subdivided conductors and coils wound in special manners with the object of decreasing the copper losses. The investigation differentiates between the cases of windings carrying alternating current of sine form and direct-current windings that carry alternating current of very different wave form, also between the cases of single-layer and double-layer windings. The arrangements described include the use of multiple conductors twisted in the slots so that individual strands occupy varying positions in the slots, the use of twisted end connections between the conductors in the slots and the constructing of former-wound coils in such manner that individual conductors and strands occupy the most advantageous positions in the slots. The technical constructions are fully described and illustrated by photographs and sketches. It is concluded that additional copper losses may be practically eliminated in alternating-current windings with at least two, and in direct-current windings with at least four layers of conductors per slot. Twisting of the end connections at both ends of the armature should be adopted very generally.—*Archiv. f. Elektrotechnik*, Vol. V, page 1, 1916; abstracted in *Science Abstracts*, Section B, Jan. 31, 1917.

Generation, Transmission and Distribution

Faults to Earth in High-Tension Networks.—W. PETERSEN.—The magnitude of the current to ground occasioned by a fault in a network is of prime importance in influencing the reliability of that network. If the current to ground is too great, breakdowns are likely to occur in the shape of damage to insulators, opening of switches, short-circuits, melting of fuses in the circuits of the line transformers and appearance of excess voltages. An illustration is given of the interconnection of two small networks that operated satisfactorily separately, but were subjected to excessive disturbances when running jointly with the addition of a small extension. Experience shows that safe maximum values for the current to ground are 3 amp., or 2.5 amp. per 100 km., and 10 kv. for lines with or without guard wires respectively. In the case of underground cables the currents to ground may reach values lying between 40 and 100 amp. per kilometer and kilovolt. Arcing grounds die out of their own accord if the current is not greater than about 5 amp. in 10-kv. to 20-kv. systems and the destructive effects increase with the current, reaching a maximum violence at about 15 amp. The magnitude of the current to ground may be limited by subdivision of the network into a number of separate sections fed by transformers, so that the sections are not in direct electrical contact. If the high-tension mains cannot reach outlying sections conveniently, such sections may be isolated by being coupled to the system by 1 to 1 transformers. Automatic grounding switches afford a good protection in cases where a sufficient reduction of the current to earth is not attainable by the above-mentioned subdivision, *i.e.*, in systems above about 20 kv. The operation of such switches transfers the arc to a point where it can be interrupted without destructive effects. The grounding switches open shortly after closing, and if the fault is removed they then remain open. In case the ground persists the switch remains closed after opening several times. An appendix contains calculations of the magnitude of the capacities between conductors and between conductors and ground and of the resulting currents to ground in various systems of transmission with various line voltages. In the case of three-phase overhead lines the currents to ground, when one line is grounded, are of the order of twice the charging current per line when the ground is not present. In the case of underground cables the current to ground under these circumstances is only about 50 per cent greater than the charging current.—*Elek. Zeit.*, Sept. 14 and 21, 1916; abstracted in *Science Abstracts*, Section B, Jan. 31, 1917.

Installations, Systems and Appliances

Depreciation of Plant.—F. GILL and W. W. COOK.—A paper presented before the (British) Institution of Electrical Engineers on the principles involved in computing the depreciation of plant from an engineering standpoint. The general conclusions are as follows: There is only one common method for the financier, the accountant and the engineer. This common method is best studied in the annual charges for plant, determined in advance of construction. To determine the amount in the annual charges for depreciation it is necessary to estimate the first cost, residual values, and the physical and economic lives of the various classes of plant. It is also necessary to fix the treatment of the capital amount and to estimate the charge for return on capital. The interest to be earned by the reserve funds must be credited to its source. The reserves are preferably handled by means of two funds as follows: (a) A renewals fund for providing the necessary money at the end of the physical life; that is, the end of the period during which the plant will give its service satisfactory under all conditions outside the owner's control. (b) An improvement fund for providing sufficient additional money to enable the plant to be taken out of commission for reasons within the owner's control and while it is still giving its service satisfactorily. The calculation of the amounts to be contributed to these two funds must include the interest which should be earned by the money before it is required at the end of the life. The amount, calculated as above, which should be in the renewals fund, gives the correct diminution in value, when considering the value to the owner, of the plant in place and working, at any period in its history. The amounts, calculated as above, which should annually be put to the two funds for renewals and improvements determine the correct depreciation charge against the undertaking for the purpose of assessing profits, fixing rates, and, under certain conditions, assessing the value of an undertaking as a going concern. The sinking fund method fulfills all the requirements. The straight line method does not. All estimates, such as first cost, physical and economic lives, and interest earned by funds,

will require revision from time to time, either as a result of experience or of changes in conditions.—London *Electrician*, Jan. 12 and 19, 1917.

Wires, Wiring and Conduits

Electric Porcelain.—Before the war most porcelain articles for electrical purposes used in France were imported from Germany, but since the beginning of the war a French industry has been started for the manufacture of electric porcelain. The present instalment deals with the raw materials required for the porcelain and the glaze. The article is to be continued.—*Revue Gen. de l'Elec.*, Jan. 6, 1917

Porcelain Suspension Insulators.—HARRIS J. RYAN.—A paper in which the fundamental requirements in satisfactory insulators for high-voltage lines are summarized, and particular emphasis is placed upon the need for co-ordinated study of service durability. The general conclusions are as follows: Appreciably porous porcelain should not be employed for suspension insulators. Under the action of the elements their failure must occur in due course of time. Cement used for setting up cap and pin type suspension insulators should be non-porous or rendered non-porous. Recognition of porosity as a contributing cause of suspension insulator failure has not lessened the importance of design features that reduce cracking through differential thermal expansions and failure through electrical overstresses and the heat of heavy flash overs. Defective materials in otherwise well-designed and manufactured insulators have been responsible for most of their service-durability failures. Clear fused quartz appears, technically, to be a desirable substitute for porcelain in the construction of suspension insulators. The same issue contains papers by J. Cameron Clark and J. E. Woodbridge on the same subject.—*Proceedings* Amer. Inst. Elec. Engrs., January, 1917.

Units, Measurements and Instruments

Errors of Direct-Current Ampere-Hour Meters.—A theoretical discussion of the errors of ampere-hour meters, both of the mercury and commutator meter type. Considering first an ideal meter of either type, without solid or fluid friction, in which the same field is used for braking and driving, we have, C being current, B flux, ω angular speed, a and e constants, equating torques, $e\omega B^2 = aCB$, hence $\omega = aC/eB$, showing that the speed of a meter for a given current is inversely proportional to the flux. In the case of a meter with solid friction only, f being the fractional torque, the fundamental equation is $aBC = eB^2\omega + f$, hence $\omega = aC/eB - f/eB^2$. The error is accordingly $-f/eB^2$, varying inversely as B^2, which emphasizes the advantage of powerful magnets. For a meter with an armature at rest and with a current infinitesimally less than the starting current we have $F = aBC_s$, where C_s is the starting current and F is the standing-still friction. If f is the friction when the rotor is moving, we may take as a rough approximation $F/f = n = 3$ for a mercury meter and $= 1\frac{1}{4}$ for a commutator meter. We have accordingly $f = aBC_s/n$. The error can now be written $-aC_s/neB$. The percentage error η is, therefore, $\eta C - 100C_s/nC$. This error is the difference between the actual and ideal speeds of the meter. The results obtained apply with close approximation to a commutator meter, and also to a mercury meter at low speed. The case of a meter with both solid and fluid friction is next taken up and the assumption is made that fluid friction introduces an error proportional to ω^2 or approximately proportional to C^2. The error may be written $-f/eB^2 - gC^2$, g being a constant, the percentage error $\eta_1 = 100C_s nC - mC$, m being a constant. The shape of the curve is now altered. There is now a minimum arithmetical error for a finite value of C. The curve can be constructed by adding the ordinates of the original curve to those of a straight line $x = mC$. The shape of the curve is very little modified for the lower speeds of the meter. The result of the correction for fluid friction by weakening the flux by an amount proportional to the current may be investigated as follows: The speed, neglecting errors, without the correcting device is $w = aC/eB$. The increased speed due to correction is $\omega' = aC/e(B - SC)$, S being a constant. We therefore obtain very approximately, SC being small, $\omega' - \omega = aSC^2/e^2B^2$. The result of the correction as regards the errors of the meter is of the second order of smallness and may be neglected. As the result of the correction of the meter is proportional to C^2, its effect is to diminish the constant m in the equation, giving the error of a mercury meter, and in no way to alter the nature of the curve. By increasing the number of turns in the correcting coil, it will be possible almost exactly to counteract the effect of fluid friction, or even to overcompensate the meter. This is rarely done, and it is advisable slightly to undercompensate the meter. Fig. 2 will make these results clear. The

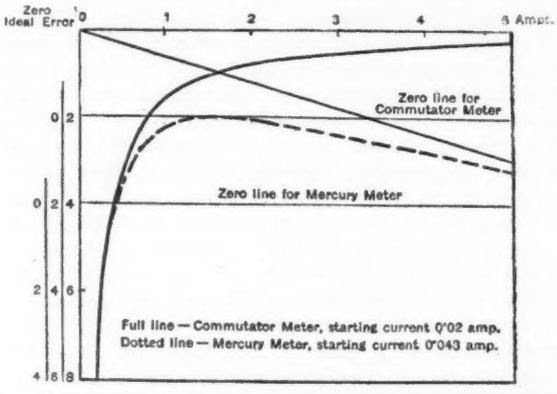


FIG. 2—RELATIVE ERRORS OF MERCURY AND COMMUTATOR-TYPE AMP.-HR. METER

full-line curve is a rectangular hyperbola and represents the performance of a commutator meter. The straight line represents the effect of uncompensated fluid friction, and the dotted curve represents the effect of both solid and fluid friction as found in a mercury meter. A consideration of these curves will show very clearly why a mercury meter gives greater accuracy at low loads than a commutator meter. With a commutator meter the full-load speed is relatively the greatest, and the zero inaccuracy line has so to be adjusted that at this load the meter is not more than 2 per cent fast. With a mercury meter, the speed at full load is relatively much smaller, and the zero inaccuracy line can be adjusted to a lower position, as shown. It will be seen from the diagram that, although the ideal error of the two meters at 0.25 amp. may be the same, the inaccuracy of the commutator meter will be 2 per cent greater than that of the mercury meter. It will also be clear that it is advantageous for the curve of the mercury meter to drop slightly at the higher loads, as this allows the zero inaccuracy line to be shifted to a lower position than otherwise. For a mercury meter the smallest arithmetical error occurs when C equals $\sqrt{p/m}$. The three criteria necessary to determine the accuracy of a mercury meter are tests at full load, at load of minimum arithmetical error, and starting current. If these criteria are satisfactory, other tests are superfluous. In the case of a commutator meter two tests are sufficient to determine its accuracy, starting current and full-load speed.—London *Elec. Rev.*, Feb. 2, 1917.

Scientific and Industrial Research

A Department Devoted to Interchange of Ideas, Investigations Contemplated, Research Facilities Available, and Suggestions for Co-operative Work.

Conducted by PROF. VLADIMIR KARAPETOFF
Cornell University

FOREWORD ON THE SCOPE OF THE RESEARCH SECTION

This section is started without preconceived ideas, but with a sincere desire to serve the interests of electrical research and of investigators. In it will be embraced:

1. Interchange of ideas among investigators in the electrical industry and in pure science on some important problem to be solved.
2. Questions regarding some topic in research to be undertaken.
3. Suggestions and answers to questions from those who are in a position to advise.
4. Brief reports on some electrical research in progress or results obtained.
5. Information regarding facilities available for electrical research in private, federal, technical-school or public service company laboratories.
6. Discussions and tabulations of some important research problems in the various branches of electrical industry and science with the idea of concentrating the attention of the investigators on those problems.
7. Suggestions and arrangements for co-operative research where it is superior to uncorrelated individual efforts.

Short contributions bespeaking the support of electrical research, or that tend to enhance its dignity and show its importance in the cultural standing, prosperity and safety of the country, will also be welcome.

A few experienced, skilled and competent investigators cannot of themselves accomplish much, any more than a few generals without an army. A large number of young electrical engineers and physicists must be encouraged and interested in research, because from their ranks future great investigators will arise. Many will become useful assistants in research, still others will at least realize the importance of research and will encourage it when they reach positions of authority. Above all, a circle of sympathetic readers must be created who will follow research, delight in new achievements, and lend moral and material support to faithful workers. Otherwise the section will be like a major league team playing a spirited game before an empty grandstand.

This, then, is a request for co-operation from those who are interested in research, be it practical or theoretical. Let the profession know what you are doing and how you are doing it. Let us all rejoice in your triumphs, and let us lighten your difficulties or disappointments if possible. If the task is too large for you, others may be willing to co-operate and help achieve results.

Following are some suggestions as to how you can do your share in this great and important work of inventorying and stimulating electrical research:

1. Indicate the most important problems in the branch of electrical engineering in which you specialize. These may be problems on which you are working, or suggestions for investigations by others.
2. Give a brief account or at least titles of investigations that you are conducting, or of the research recently done under your supervision. This information will be published for the purpose of bringing together those working on some problem now, and also those who may take it up later.
3. Describe briefly the experimental facilities at your disposal and the kinds of problems for which they are particularly suitable; also other facilities that you may possess, such as a large amount of data on file, a collection of pamphlets on some topic, natural advantages of location, etc.
4. Ask questions, if you have any, or express a desire to get in touch with other investigators on some topic.
5. Give your general views on electrical research and on how to encourage it and make it more productive.

Investigations Planned or Under Way

A thesis is being prepared by the writer on phenomena accompanying the rupture of electric circuits. References on the subject and suggestions as to the method of treatment would be welcome. M. J. IDAIL.
Washington, D. C.

Three investigations are now in progress at Washington University:

1. A study of pole-face losses. For this work there has been designed and constructed a special piece of apparatus, which will make it possible to determine the pole-face losses in terms of each of the variables upon which the loss depends.
2. A study of the effect of artificial illumination during daylight hours.
3. A study of the non-synchronous rotary gap. Some interesting results have been obtained, showing that there is an energy component in the charging current of the condenser. The derived mathematical expressions have been satisfactorily checked by experimental determinations. A. S. LANGSDORF.
Washington University, St. Louis.

The electrical strength of air is being investigated with a view toward explaining the nature of the breakdown of air. The work that is under way at present includes an accurate investigation of the conditions governing the formation of corona in the constituents of air, and also in several other well-known gases.

In addition a corona voltmeter is being perfected, the work under way at present being the development of a method for directly measuring the crest voltage of a high-tension circuit.

The object is to determine, beyond all question, the constants which enter into the formula for the inherent calibration of the corona voltmeter. In conducting these experiments it is hoped to demonstrate that the corona voltmeter constitutes a standard for high voltage measurement and also a convenient measuring instrument which surpasses anything that is now available.

A new method for measuring iron losses up to 3000 cycles is also being developed. In doing this comparative determinations are being made by present methods.

Within the past three years considerable information has been secured on the laws governing the formation of corona in air, a corona voltmeter has been developed, and an exhaustive study of the errors arising from improper connections of polyphase watt-hour meters, has been made, with the proposal of a method for avoiding these errors. Incidentally a portable gold-leaf electroscope has been developed. J. B. WHITEHEAD.
Johns Hopkins University.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

E. W. RICE, JR., IS NOMINEE FOR A. I. E. E. PRESIDENT

Inventor and General Electric Company Executive Named by Directors of the American Institute of Electrical Engineers

The nominee of the board of directors of the American Institute of Electrical Engineers for president in the next year is E. W. Rice, Jr., of Schenectady, N. Y. The nomination of the directors is virtually equivalent to election. At the meeting of the board held in Chicago

E. W. RICE, JR.

on March 9 the report of the committee of tellers on its canvass of the nomination ballots cast for candidates for the offices falling vacant on July 31, 1917, was presented. Following the requirements of the institute constitution, the board then selected by ballot its list of "directors' nominees" as follows:

For president:	E. W. Rice, Jr., Schenectady, N. Y.
For vice-presidents:	Frederick Bedell, Ithaca, N. Y. John H. Finney, Washington, D. C. A. S. McAllister, New York, N. Y.
For managers:	Walter A. Hall, West Lynn, Mass. E. H. Martindale, Cleveland, Ohio. William A. Del Mar, New York, N. Y. Wilfred Sykes, Pittsburgh, Pa.
For treasurer:	George A. Hamilton, Elizabeth, N. J.

Regular ballots will be mailed to the members before April 1.

TECHNICAL CAREER OF MR. RICE

Edwin Wilbur Rice, Jr., inventor, pioneer in the electrical industry, president of the General Electric Company, has been successful in many lines of engineering activity.

Because of his early devotion to the fortunes of the infant electrical industry Mr. Rice has had an exceptional relation in its initial struggles and the crowning epochal development of later years. Born at La Crosse, Wis., on May 6, 1862, he attended the Central High School in Philadelphia. In 1880 he decided to forego the college education upon which he had set his heart and give himself to the work of assistant and confidant of Prof. Elihu Thomson in the newly organized American Electric Company, New Britain, Conn. Professor Thomson, who had been teaching mechanics and chemistry in the high school, had been attracted by the skillful work of his pupil. In 1882 the company was acquired by H. A. Pevear, C. A. Coffin and Silas A. Barton, and its headquarters were moved to Lynn as the Thomson-Houston Company. With rapid growth, greater capital and confidence Mr. Rice combined in rare degree the practical ability of the business man with the untiring resource and penetrating research of the inventor searching for the answer to problems that pressed rapidly upon the advanced workers in those early days. With the duties of superintendent of the works, which fell logically upon his young shoulders, he combined continuous attention to the technical questions which first attracted him. Their growth and ramifications drew his fascinated study, and he contributed greatly to the technical steadiness and progress of the industry.

The General Electric Company, combining the Thomson-Houston Company and the Edison General Electric Company, was formed in 1892, with Mr. Rice taking the responsibilities of technical director. His close association with the advance of this company is illustrated by his official positions in it. Becoming third vice-president in charge of technical and manufacturing departments in 1896, he was the senior vice-president later. Upon the election of Mr. Coffin as chairman of the board of directors in 1913 Mr. Rice was made the president. He has been an active co-worker and supporter in the affairs of the institute and in many large and important movements has been of distinct service to it, laboring in a quiet way for its welfare and wholesome influence.

INSULL ADDRESSES THE PITTSFIELD SECTION A. I. E. E.

President of Commonwealth Edison Company of Chicago Predicts Great Development of Low-Head Water Powers in Middle West if Coal Continues High

About 275 people were present at a dinner given for Samuel Insull, president of the Commonwealth Edison Company of Chicago, by the Pittsfield Section of the American Institute of Electrical Engineers, at the Wendell Hotel, Pittsfield, Mass., on the evening of March 14. The toastmaster was V. E. Goodwin, chairman of the local section. Among those present were Ex-Senator Crane, E. W. Rice, Jr., C. C. Chesney, W. A. Hall of Lynn, and G. Faccioli.

Mr. Rice introduced the speaker of the evening, Mr. Insull, whose subject was "Some Developments in Electric Utility Operations."

In his address Mr. Insull showed by a number of curves and views the rapid development of the Commonwealth Edison System, emphasizing the value of the concentration of generating capacity and of distribution as well as the engineering methods of disposing of the power. He directed particular attention to the need for further improvement in the operating characteristics of boilers and turbines and predicted

that there will be great development of low head water powers in the Middle West if the present high price of coal is permanent.

Mr. Insull also stated that the uses of electricity will increase enormously in the future, and that many more of the steam roads will be electrified.

HALFORD ERICKSON BEFORE WISCONSIN ASSOCIATION

Former Chairman of Railroad Commission Addresses Meeting at Milwaukee—Affiliation with National Electric Light Association

Fair rates of return on utility investment, rural electrical service, affiliation with the National Electric Light Association, methods of levying taxation on utilities and the Railroad Commission's methods of rating utility service were the topics discussed at the first day of the ninth annual meeting of the Wisconsin Electrical Association at Milwaukee on March 14. The feature of the convention was the paper on "Rate of Return," by Halford Erickson, the former chairman of the Wisconsin commission. He pointed out forcibly that, to be willing to supply additional capital, the investor must be able to see that the plant has net earnings which altogether amount to not less than 8 per cent on the face value of the plant, its equities and business. With a much lower net income than about 8 per cent, concluded Mr. Erickson, on the face value of its plant and its business the property could not in the light of the facts very well be placed in the investment class.

The report of the committee on rural service by A. C. Babson, Watertown, shows that this part of the business is on the increase in Wisconsin and that it is generally thought profitable under the conditions imposed by operating companies.

Affiliation with the National Electric Light Association was referred to the executive committee with power to act and with the recommendation that the Wisconsin Electrical Association become a geographic section. A committee report, favoring legislation to eliminate the local assessor and replacing his work by that of the state Tax Commission, was approved.

MARGIN BETWEEN COPPER AND ALUMINUM PRICES

Lessening of the Difference Between Costs of the Two Metals Suggests New Possibilities in Substitution

Aluminum continues to be quoted at the purely nominal market price of 58@60 cents per pound. The outside market, upon which these quotations are supposed to be based, represents only a small volume of trading, as the factors of supply and demand are influenced so largely by war conditions. Actual prices are fixed by the conditions prevailing at the time of a sale.

Much interest is shown by authorities in the trade in the action of various central station companies which have scrapped aluminum transmission lines because of the high value of the metal, substituting therefor copper wires. It is felt, however, that the lessening of the margin between the prices of the two metals substantially reduces the profit obtainable and that it has made such substitutions unlikely under present conditions.

The future price of aluminum is bound up so closely with the question of war that ordinary commercial considerations disappear, but some authorities are suggesting the possibility that if copper continued to be high, aluminum, if obtainable, may look inviting.

NEW BUSINESS COMMITTEE MEETING AT DAYTON, OHIO

Many Timely Subjects Discussed and Good Suggestions Developed at Successful Gathering of the Ohio Committee

The amount of "free service" which a central station should give to its customers received special attention at the new business co-operations committee meeting of the Ohio Electric Light Association, Dayton, Ohio, on March 14. O. A. Acuff, of the Massillon Electric & Gas Company, who presented this paper, specially emphasized the importance of instructing consumers as to proper handling of appliances, and thought that central stations should not give free repair service. Mr. Reemelin, of Dayton, outlined the liberal Dayton plan of investigating all trouble on customers' premises, replacing fuses quickly, repairing all appliances, and charging customers only for material. He thought that labor should be given gratis. C. E. Yacoll, J. L. Stone and E. R. Kelsey offered further discussion.

Another important subject which excited great interest was "The Manufacture of Raw Water Ice," by R. C. Hayes, of Cincinnati. Mr. Hayes pointed out that the manufacturers of electric driven refrigerating apparatus are offering the services of their sales engineers to assist all central stations in securing ice and refrigerating business.

F. J. Woltz, power engineer of the Union Gas & Electric Company, of Cincinnati, in his paper, entitled, "Financing Motor Installations," detailed the advantages of trial installations of motors which have proven so successful in Cincinnati. F. B. Steele stated in the discussion of this subject that this method of power sales had given 100 per cent returns in Dayton. Mr. Craft, of Columbus, suggested that the financing of the motor installation was entirely a local problem. Mr. McGregor, of the Merchants' Light, Heat & Power Company, of Indianapolis, thought that it would be inadvisable to establish a policy of financing motor installations, but considered the problem analogous to that of financing heating appliances.

E. P. Hollingsworth presented for discussion the subject of commercial rates which aroused considerable interest.

The closing paper of the afternoon was by F. H. Hooper, new business manager of the Northwestern Ohio Light Company, with the caption "Motion Pictures as an Aid to New Business." It was especially interesting and presented a moving picture story, showing the housewife changing from the old style of cooking to the modern electric method.

The new business committee was entertained in the evening by a program and banquet at which the members were guests of the Dayton Jovian League.

EXTRA SESSION OF CONGRESS OPENS WAY FOR LEGISLATION

Opportunity for Action on Water Power and Export Combination Bills as Well as on International Matters

The Senate having revised and altered its archaic rules by a method which will permit two-thirds of those present to force a vote on measures before it, President Wilson has called an extra session of Congress to meet April 16. It is understood that there will be more than sufficient opportunity during the summer for the transaction of other business than that pertaining to international matters, such as the passage of the water power bills, the Webb bill, etc.

CREATIVE WORK OF THE ASSOCIATED MANUFACTURERS

Annual Report of Robert K. Sheppard, the President, Sets Forth the Unity of Purpose and Ideal of Usefulness Which Characterize It

What powers for national usefulness are within your control through the co-ordinating forces of this association!—President Robert K. Shepppard.

The annual meeting of the Associated Manufacturers of Electrical Supplies, the culminating feature of a year of highly successful constructive effort and accomplishment, was held at Delmonico's, New York, during the afternoon of March 15. It was followed by a banquet in the evening.

It was a disappointment to the members that Robert K. Sheppard, sales manager of the Simplex Wire & Cable Company of Boston, who has served as the president of the association since its organization, was prevented by illness from attending the meeting. He, however, prepared his annual report, which was presented for him in his absence. An abstract of the address of Mr. Sheppard is published below, and it will be followed in next week's issue of the Electrical World by a report of the proceedings:

Address of Robert K. Sheppard, the President

"At the close of this second year we have sound reasons to be glad that we are banded together in this association. Enduring friendships have multiplied. Trusting our comrades, our trust has been reciprocated. Contributing frankly and freely from the discoveries of our manufacturing past to remedy mistaken or uneconomical practices, we still have not given more than we have received from all our associates.

"Many as are the material benefits derived from the work of our sections, not all of them together can equal in intrinsic value the worth of that spirit of mutual helpfulness which has permeated all of our activities.

"And so, at this anniversary time we have unity of purpose, an ideal of usefulness, a scheme of activities, and the machinery with which to work out that scheme for the common weal.

"At this stage in the terrible war under which the world suffers, what powers for national usefulness are within your control through the co-ordinating forces of this association! How much more fit to-day is this group of nearly eightscore manufacturers to work together for great ends than those same manufacturers were two years ago before sensible co-operation had become a habit and this mechanism for concerted effort had been well tested!

"Your organization into sections has laid permanent foundations, while your work together these many months has begun to raise the superstructure of a veritable hive of industry in which good-will and mutual confidence are the binding mediums.

"You have been willing to consult, to collaborate, to search out the essentials, to surrender the non-essentials; you have determined to harmonize individual aspiration with fair dealing; each of you has helped the rest of us to broaden our visions until we can see our common problems from the differing standpoints of the others interested with us.

"Recently, by unanimous vote, one of your sections recommended to the Underwriters' Laboratories that an adequate method should be provided whereby approval under the installation rules of the National Fire Protection Association should be given without unreasonable delay to new products, when such products had been thoroughly tested by the Underwriters' Laboratories and found to be safe and suitable for the intended service. That competing manufacturers should thus unitedly indorse a sound principle, which makes for fair dealing between competitors and toward the consumers of electrical products, is to my way of thinking a splendid testimonial to their unselfishness and the integrity of their purpose to deal justly by one another.

A Basic Industry

"The promotion era of the electrical industry is over. Now the industry must be classed as one of the basic industries of the country like steel production, cotton manufacturing, machinery building, railroading, mining of coal and minerals. For it the age of wonders still holds some secrets, but when disclosed they will constitute refinements of the art, rather than fundamental forces in this enormous business.

"In the last thirty years electric power, light, transportation, the telegraph, the telephone could not be provided too fast. The world was quick to speed up proportionately in the race for domination of nature's forces and the achievement of wealth and material comfort. Magical expansion was accompanied by almost uncanny prosperity, in which phenomenal profits completely buried the unsuspected losses due to waste and a total disregard of the ratio of cost to selling prices.

"But that period has passed. The spendthrift manufacturer, the blind adopter of his competitors' market values and methods, can no longer find shelter from the financial cyclone.

"Our industry has trodden the same historic path which has forced every other basic industry to a closer and closer study of the costs of production and the costs of distribution.

"Under appointment by the Electrical Manufacturers' Council, a committee led by C. E. Patterson of the General Electric Company has prepared a comprehensive, yet flexible, plan of accounting and cost estimating which, ere long, will be available.

Beneficial Relations with Underwriters' Laboratories

"With the Underwriters' Laboratories the relations of our members have been increasingly harmonious and mutually beneficial. The laboratories have established many industry conferences which are integral parts of the organization of the Underwriters' Laboratories. In those industry conferences representative manufacturers advise and consult with the officials and engineers of the laboratories concerning suitable test methods and requirements for the laboratories to adopt, and desirable changes in standards to be recommended to the electrical committee of the National Fire Protection Association. When standards are to be discussed or adopted, surely men are wise to combine with laboratory theory and findings the practical experience obtainable only in the factories which produce the goods that are supposed to compare favorably with the desired standards.

"The founding of industry conferences was a wise act, which has so related the activities of the Underwriters' Laboratories to the necessities of the manufacturers, that the rulings of the laboratories, promulgated from time to time, generally find hearty indorsement by the manufacturers whom they affect. It is desirable that other governing bodies throughout the country should realize how greatly the policy of the laboratories has promoted the adoption of reasonable and attainable standards for the ultimate benefit of our entire people.

"As an association we are a member of the National Fire Protection Association. We have asked for representation on the electrical committee of that body and are confident that such representation will help the

manufacturers of electrical supplies to co-operate rationally, although directly, with the fire underwriters doing business in the United States, to the end that losses of property and life by fire may be lessened.

WORK AHEAD

"Have you yet discovered the usefulness of accurate statistics collected by industries? Have you considered what kind of statistics will be most useful to the manufacturers of porcelain; what kind are helpful to those who make such varied products as the members of the molded or Formed Insulation Section or the Wire and Cable Section?

"Tonnage data may be useful to one group of manufacturers; payroll data to another. The kind and number of materials for manufacturing certain products, and to be found in one industry, may give some group of manufacturers useful information. Other manufacturers may be able to utilize to better advantage statistics which tell the gross business in dollars or the ratio of direct labor payroll to gross billings. A knowledge of the number of men and women employed at direct labor, if recorded month by month, or quarter by quarter, may give statistical data of great value to some of your groups.

"Through your central organization, the board of governors, you may employ expert certified accountants to whom confidential data may be delivered with assured secrecy. Such accountants would combine the individual reports of a group of manufacturers and subsequently distribute to each the totals, or the averages, or such other details as the members of that group might require. Your board of governors might use the same accountants for the work of several different sections, segregating to each section its rightful proportion of the charges of those accountants. In that way the financial burden would be as little as possible for each group of manufacturers.

"From time to time, as one group after another discovers a special need, the methods for meeting that situation need only be submitted to your counsel and your board of governors to receive their hearty indorsement, if the procedure is lawful and expedient for such an organization as ours."

EMPIRE STATE ELECTRIC DISTRIBUTION COMMITTEE MEETS

Fifty-five Delegates Gather at Buffalo, Discuss Important Topics and Visit New Generating Station

The electric distribution committee of the Empire State Gas and Electric Association held a meeting in the auditorium of the Buffalo General Electric Company, Buffalo, on March 9. Fifty-five delegates were present.

F. A. Alcott, Rochester Railway & Light Company, read a paper on "Methods for Selecting Size of Transformers to Prevent Over-transformering or Under-transformering on a.c. Lighting and Power Systems, and the Testing of Transformers for Overload, Defective Oil, etc." This paper was prepared in accordance with the plan of the committee to have a complete and detailed report prepared during the year on one subject which would be of interest to a majority of the members. W. C. Blackwood, chairman of the committee, explained the purpose of the committee in following this plan.

Connection of consumers to high tension transmission lines was the next subject. Much discussion took place on satisfactory methods of grounding secondaries where water piping systems cannot be used. Methods of improving regulation and control of primary circuits outside of station apparatus were discussed before the end of the morning session.

F. B. Van Doren of the Utilities Mutual Insurance Company spoke on accident prevention work at the afternoon session. Methods of reducing the amount of overhead construction to avoid agitation for underground construction were then discussed. The use of fir arms versus pine arms, treated and untreated, was the last subject. It was pointed out that either is strong enough for average loads.

A number of the delegates visited the new generating station of the Buffalo company.

SAMUEL SCOVIL ON COAL SHORTAGE IN CLEVELAND

Seriousness of High Cost and Heavy Financial Losses a Greater Problem Than Actual Shortage of Supply

Samuel Scovil, president of the Cleveland Electric Illuminating Company, states to the ELECTRICAL WORLD:

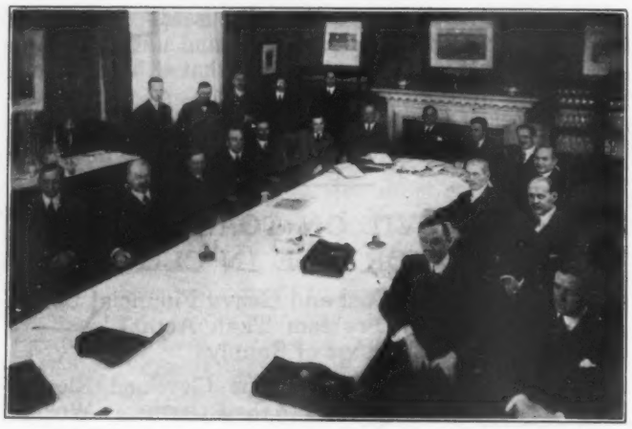
"The coal situation in Cleveland has been more a matter of price which has had to be paid for it than an actual shortage. There have been some short periods when the supply caused us more or less anxiety. During these special periods the congestion of traffic on the railroads became so accentuated by reason of storms and severe weather that embargoes on the shipments of coal as well as other commodities were resorted to by the railroads, but the periods did not last long enough to cause the general inconvenience which some other less happily situated centers seem to have suffered.

"The large users of natural gas during the severe weather found the supply was somewhat inadequate, due partly to the fact that the gas company was unable to get a new supply line to Cleveland.

"As stated above, while there has been no actual shortage of coal, the users of it have, however, suffered heavy financial losses by reason of the price which it was necessary for them to pay for the coal. The normal price of steam coal in Cleveland for many years past has been less than $1.80 per ton. About the middle of October coal began to go above this price, and by the end of November the price for it ranged from $3 to $5.65; in December from $3.25 to $5.80; January $4.50 to $5.60, and February $4.55 to $6.20. At this writing the market is about $1 a ton less than the maximum price. As the time for more favorable weather for transportation operations approaches, there is more disposition on the part of the coal companies to make contracts covering periods of from one to five years. These contracts, however, are made on the basis of coal f.o.b. cars at the mines, the purchaser having to take all the chances of car supply, freight rates, and transportation delays. If the purchaser is willing to accept these contingencies, producers will consider contracts on a basis of about $3 a ton at the mines for one year, and from $2.55 to $2.75 for three years, and for something less than these figures for longer periods. The freight rate to Cleveland from the mines which usually supply it with coal runs from 70 cents to $1.25 per ton.

"The users of central station service in Cleveland have been asked to pay no part of the additional operating cost which these high prices for fuel have occasioned. None of the manufacturing or commercial establishments depending for their power on central station service were inconvenienced in the slightest, nor was there any suggestion made to them at any time that they need curtail their operations, thereby saving all the anxiety which those who were depending upon their own independent plants were subjected to."

LARGE OPPORTUNITIES STIR THE N. E. L. A. ELECTRIC RANGE COMMITTEE



As reported in last week's issue of the ELECTRICAL WORLD, a two-day meeting of the electric range committee was held at the New York headquarters of the National Electric Light Association on March 5 and 6. Twenty members were present and Chairman Michel presided.

ELECTRICALLY-EQUIPPED FURNITURE DEVELOPMENT

Merchandising Committee of the N. E. L. A. Finds a Fertile Field for Cultivation and Urges Exhibit at Atlantic City Convention

A feature of the present work of the merchandising committee of the Commercial Section of the National Electric Light Association is its study of electrically equipped furniture. As stated in last week's issue of the ELECTRICAL WORLD, the principal topic under discussion at the meeting of the committee, held in New York on March 6, was the promotion of such furniture and arrangements for a display of it at the Atlantic City convention.

The committee sent a letter early in the year to several hundred manufacturers of furniture in this country and Canada asking for information of what they had done in the design of electrically equipped furniture, and calling attention to the possibilities of development in this direction. It is found that the manufacturers are greatly interested.

EXHIBITION PLANS FOR THE N. E. L. A. CONVENTION

Committee Has Obtained Nearly Double the Space Occupied in Former Years and Promises Unusual Displays

The exhibition committee of the National Electric Light Association, of which H. G. McConnaughy is secretary, has completed all details in connection with the exhibition to be held in conjunction with the convention of the National Electric Light Association at Atlantic City during the week of May 28.

The floor plan shows an unusual layout, not only for the manufacturers, but for the association as a whole, as it will be necessary to pass through the exhibit space to get to the meeting rooms. This condition has not existed at other conventions in recent years. The meeting rooms are all together, which is another feature of importance. The lamp committee will have an unusual exhibit located at the rear of the hall of exhibits and next to the meeting rooms. In addition is the fact that the pier will be the only headquarters, not only for the meetings and exhibits, but also for all entertainments during the day and evening, as well as for registration and work of the committees.

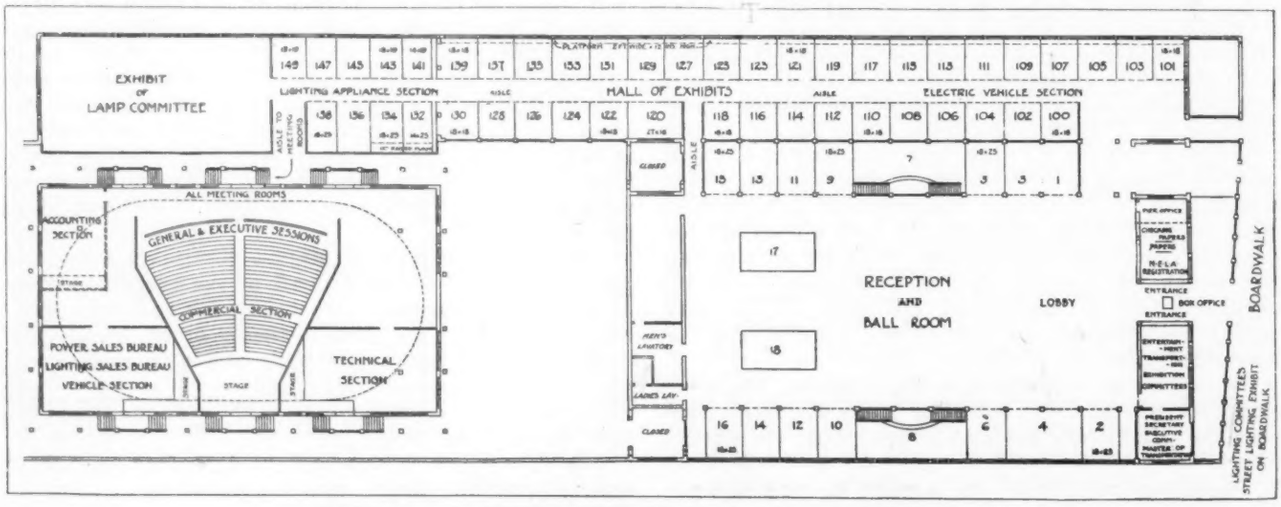
The exhibition committee announces that it has been able to secure almost double the space occupied in former years, which will enable it to take care of the many Class D members who have been unable to secure space during the last few years. The committee has also been able to reduce the cost of space by less than one-half of any previous exhibit.

The plans of the lamp committee, mentioned above, include an unusually attractive and educational exhibit which should be valuable to all central station members. This committee has been assigned 5000 sq. ft. of space. The lighting sales bureau and other bureaus are greatly interested in this exhibit.

The lighting appliance section is located in the same room as the lamp exhibit. This will give an opportunity to manufacturers of lighting appliances to make a unique exhibit in connection with the lamp committee.

The Electric Vehicle Section will be located in front of the exhibition hall near the main entrance, and will be an exceptional location.

The exhibition committee urges all Class D members to forward applications on receipt of its notices. While it has been able, as stated, to secure much additional space, the advance requests and the interest being taken in the exhibits by the association, as well as the committees and bureaus, assure the use of all space.



THE PLAN OF EXHIBIT BOOTHS FOR THE N. E. L. A. CONVENTION

ENTERPRISING CAMPAIGN OF N. E. L. A. MEMBERSHIP COMMITTEE

Strong Intensive Effort to Enlist 1200 Central Stations, Concluding with Extended Tour by Walter Neumuller, the Chairman

Much interest is felt in the extensive campaign inaugurated by the membership committee of the National Electric Light Association, under the leadership of Walter Neumuller of the New York Edison Company, chairman of the committee. Preparations for this campaign have been under consideration for several months. During this time the committee has been making a thorough study and analysis of the central station industry of the United States in its relation to N. E. L. A. membership. It has found that there are approximately 1200 central stations located in various parts of the country which are not members of the association. Most of these are in small towns, approximately 300 being in cities of a population of 2500 or over.

With this information as a basis, the campaign will develop in three phases. The first is a letter written to each of these non-member companies, accompanied by a pamphlet setting forth clearly the association's aims and activities and the benefits to be derived from affiliation with it. This is to be followed by supplementary letters.

The next phase is the setting asjde of a week, March 26 to 31, during which an intensive effort will be made by central stations throughout the United States which are already members of the N. E. L. A. to secure those who are not.

Mr. Neumuller is communicating with nearly 500 executives of member companies asking them to call upon their non-member neighbors within convenient traveling distance of their offices, during the week designated. This personal invitation to join, it is believed, will have a decidedly favorable effect.

The third phase of the campaign is an extended tour of the country which Mr. Neumuller will make, and which will bring him into touch with the greater part of the central station industry of the country. He will visit all of the geographic section centers, where meetings and conferences have been scheduled, likewise many of the smaller cities where it is felt a personal visit of the chairman of the membership committee will bring about the desired results. He left New York on Sunday, March 11, and will return to this city about the middle of April.

ELECTRIC VEHICLE PLACE IN THE N. E. L. A. CONVENTION

Plans and Work of the Executive Committee of the Section to Further Progress and Co-operation Between Central Station and Manufacturer

A meeting of the executive committee of the Electric Vehicle Section of the National Electric Light Association was held at the headquarters, New York, on March 8. The following were present: E. S. Mansfield, chairman; E. P. Chalfant, F. M. Feiker, representing James H. McGraw; R. L. Lloyd, W. W. Sellew, representing Arthur Williams; H. G. Thompson, P. E. Whiting, E. R. Whitney, and A. Jackson Marshall, the secretary.

Chairman Mansfield reviewed the successful special electric vehicle conference held on Feb. 14. It was decided to arrange for a somewhat similar conference of electric vehicle, battery, tire and accessory manufacturers at an early date, and Mr. McGraw was appointed the chairman of a committee on arrangements.

BALTIMORE COMPANY EMPLOYEES, RETURNING FROM MEXICO, GUESTS AT DINNER

The Consolidated Gas, Electric Light & Power Company of Baltimore gave a dinner on March 1 at which the guests of honor were employees who responded to the call of the President of the United States last June to protect our rights on the Mexican border.

CHICAGO MEETING OF THE CENTRAL DIVISION JOBBERS

Profit on Heating Devices, Volume of Dry Battery Business and Association Co-operation Discussed —Frank N. Bernardin Elected Chairman

The profit on heating devices, the volume of dry battery business and association co operation were among the topics discussed at the meeting of the central division of the Electrical Supply Jobbers' Association at the Hotel La Salle, Chicago, on March 13.

Analyses of the heating device situation showed that a large percentage of jobbers' orders from the trade for appliances are in very small lots. One jobber analyzed 200 consecutive orders and found that 50 per cent were for a single appliance. The average sale amounted to less than $3 and the profit per sale was not enough to cover the expense for handling. This analysis covered only sales made to the trade and it was pointed out that the analysis showed that profits on the heating device line are inadequate for the jobber.

Each member was urged to analyze his heating device figures to learn if his profit on this line is satisfactory. It appeared in this discussion that manufacturers have contended that poor salesmanship by the jobbers' men is responsible for the small orders. The jobbers do not agree with this viewpoint.

The situation in the dry battery field is that the jobbers' volume of business is not satisfactory, there being too many distributors.

The election of officers resulted in the choice of Frank N. Bernardin, of Kansas City, as chairman of the central division, for the ensuing year. Practically all of the committee chairmen were re-elected.

At the next meeting of the central division four committees will lead a discussion on the condition of jobbers' stocks as to staple products.

N. E. L. A. Rate Book

The "N. E. L. A. Rate Book," published by the rate research committee of the National Electric Light Association, has been issued. The book is edited by Norton, Bird & Whitman.

LARGE PLANS FOR TELEPHONE CONSTRUCTION IN 1917

Absorption of Surplus Plant Capacity by Unprecedented 1916 Business Necessitates Greatest Construction Program Ever Undertaken by Bell System

With unprecedented volume of business, facilities taxed to the utmost and rapid increases in facilities necessitated by heavy traffic burdens the American Telephone & Telegraph Company and associated properties had a year of great accomplishments in 1916. Total operating revenues of the Bell system were $264,600,000, an increase of 12.9 per cent over 1915.

Heavy Construction Requirements for 1917

Theodore N. Vail, the president, says in the report to stockholders that without the provisions for future growth and demands, the companies could not have provided for the traffic which was offered. Raw material prices averaged almost double their normal cost and at times it was impossible to get them in the quantities required.

"As it was," Mr. Vail says, "the quality of the service was at times and in some places not quite up to the high standard set in recent years, yet at no time and at no place did it break down, and by the end of the year it was on substantially a normal basis.

"In consequence of this absorption into service of the surplus plant, the program of construction during 1917 must not only meet the expected growth in stations, but must also provide for the restoration of the normal plant surplus in whole or in part.

"The prospects for the current year indicate a continuing station gain and a heavy traffic. To provide for growth and restore normal surplus plant and necessary advance construction our estimates of additions to plant during the year aggregate about $90,000,000, by far the largest program ever undertaken, but necessitated by the conditions as we now see them."

Relations with Western Electric Company

A section of the report is devoted to the Western Electric Company.

"The relations with the Western Electric Company have been attacked from various quarters, and always from the questionable standpoint of self-interest," says Mr. Vail. "This relation is substantially that of a 'manufacturing department' of the business, indispensable to every enterprise which requires the manufacture for its own use of such a variety and magnitude of apparatus and equipment of 'special,' highly technical and continually changing character, which cannot be procured or provided for in the open market.

"While it is a positive fact that it is impossible to procure from others the same character of manufacture or goods at less cost than from the Western Electric Company, or many of them even at any price, yet first cost cannot be made the deciding factor in the purchase of equipment so delicate and perishable as the telephone equipment. Depreciation and high maintenance will soon offset a very considerable saving in original expenditure. High-class service and low-class equipment do not co-ordinate.

"These relations are considered by impartial and well-qualified experts to be the most effective for their purpose, which is the production of apparatus of high efficiency, reasonable first cost, and low cost of maintenance. This can be accomplished only by the close co-operation between the operating companies, the technical departments, and the manufacturing company.

"What is there unfair about any enterprise requiring the expenditure of large amounts of money for highly specialized machinery and equipment vital to its operation maintaining its own manufacture? Why should not the ideas and suggestions originating within the system be worked out within the system itself?"

Engineering Matters

Attention is called to the value of improvements in intracontinental and transcontinental telephonic transmission of speech from the standpoint of national defense. The experimental mobilization last year demonstrated the complete readiness of the Bell plant and organization to respond to an emergency.

"The further adoption of electric traction by railroads and the continued extension of electric power lines," the report adds, "have been the occasion of great activity on the part of our engineers in studying the difficult problems of telephone operation in the neighborhood of these circuits. Important field investigations were conducted in connection with power lines in Iowa, the electrification of the Pennsylvania Railroad, that of the Chicago, Milwaukee & St. Paul Railway, and others.

Regulation

A part of the report dealing with legal matters says:

"In valuations, the present disposition of the commissions is to allow, without serious controversy, the items which are susceptible of direct and certain proof. The so-called intangibles represent elements of value which must be recognized as of large importance. The disposition has been to recognize them as elements of value and to allow them, in one form or another, so far as they have been clearly established.

"An especial effort has been made to draw attention to the distinction between regulation and management, because it is felt that a failure to recognize it would result in serious embarrassment not only to the utilities but to the public as well."

The Telephone and Public Questions

Other points characteristic of the attitude of Mr. Vail and the companies on public questions were:

"The qualities which created the Bell system were self-interest subordinated to public spirit, initiative, vision, imagination, courage and energy in creating a new, serviceable utility, developing all its potentialities, and making all possible improvements.

"The only advantage the Bell interest ever had was through creative work in developing the potentialities of the telephone service by incorporating with advance construction advanced ideas; placing those facilities for service before the public in advance of all others.

Off-Peak Traffic Needed

"If in any utility some plan can be devised which will create, for the sparse hours, a new traffic and thus increase the average by utilizing facilities otherwise idle, for such service large reductions could be made; but such traffic must not occupy the plant during the busy hours, only during the otherwise idle hours. It must be a new character of traffic not requiring any addition to either facilities or operating force.

Employees' Bonus

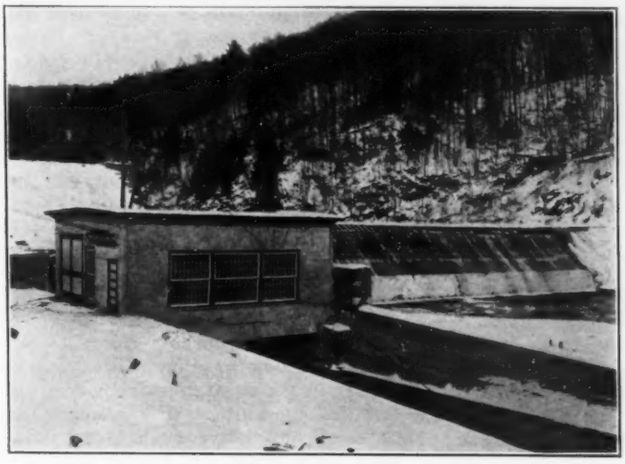
"In addition to the strain on our facilities, there was a corresponding strain on all the personnel of the system. Having due appreciation of this extra exertion, faithfulness, loyalty and prompt response to the demands of the service, on the part of our employees, as well as the extra demands upon their earnings in these abnormal times, it was deemed not only proper but advisable to share with them this surplus. Accordingly a distribution throughout the system of a very considerable part of it was made."

REMODELLED HYDROELECTRIC PLANT NEAR BRATTLEBORO

Operation Resumed After Reconstruction and Strengthening of Twin State Gas & Electric Company Building at West Dummerston, Vt.

Service has been inaugurated at the West Dummerston (Vt.) hydroelectric plant of the Twin State Gas & Electric Company, which has been undergoing reconstruction for a year. The plant is located on the West River, about 7 miles from Brattleboro, and although it is small it is utilized effectively in connection with the transmission system of the New England Power Company. The present maximum load in Brattleboro is about 510 kw. The plant was first established in 1902 as an auxiliary to the old steam generating station serving Brattleboro, its original equipment being a Stanley inductor alternator of 11,000 volts potential, driven by a Leffel water wheel, the rated output being 350 hp. The original station was designed to accommodate two units, but only one was installed. The station was run as an auxiliary about nine months of each year.

In the fall of 1915 the foundations of the plant became undermined by high water and the conditions



REMODELLED HYDROELECTRIC PLANT NEAR BRATTLEBORO RESUMES OPERATION

threatened the destruction of the station, the generator having settled about 2 ft. below its original level. Reconstruction was decided upon, with the addition of a second unit of 425-hp. rating, this machine being a General Electric generator direct driven by a Leffel turbine. About $15,000 has been spent in improving the plant. Before the changes were effected all the equipment was removed. A cofferdam was built around the power house, the foundations being excavated to a further depth of from 6 in. to 4 ft. below the former level and carried down to bed rock. A raceway wall 150 ft. long was built between the spillway discharge on the downstream side of the dam and the tailrace proper, to eliminate troubles due to ice formation. The old inductor alternator was rewound for 2300-volt service, this being the potential of the new unit, and connection with the high-tension system is made through appropriate transformers.

The power plant, originally a wooden structure, has been fireproofed by lining the walls inside and out with concrete and metal lathing, and new headgate hoists, which may be operated by one attendant, have been installed, together with a new rack at the intake. The head on the wheels is 18 ft., and the dam is a crib and stone structure 261 ft. long. When the river is at a stage permitting utilization of the water, the station carries the normal load, peaks being handled by the New England Power Company connection with the Vernon station of the latter. In case of trouble on the latter system the West Dummerston station will handle the Brattleboro load entire at such times as the river is available. A new switchboard equipped with one line and two generator panels was installed in connection with the above improvements.

PUBLICITY AND SALES METHODS FOR CENTRAL STATIONS

Speakers Before New England Section of the N. E. L. A. Say That Manufacturers' Circulars Should Be Used More Widely by Local Companies

At the question box convention of the New England Section of the National Electric Light Association in Boston, Mass., March 8, an extended discussion of publicity methods from the central station standpoint took place under the chairmanship of Willard Hall, Narragansett Electric Lighting Company, Providence, R. I. This was mentioned briefly in the report published in last week's issue. During the discussion speakers pointed out that wider use should be made by local companies of publicity matter supplied by manufacturers, but there was general agreement that this material would meet local requirements better if the manufacturer's stamp was less conspicuous. Any diversion of interest from the local company was considered objectionable. It was conceded by most speakers that national publicity relative to appliances should be supplemented by local circularizing, motion picture films, bill inserts and local newspaper advertising.

Much criticism was leveled against misunderstandings arising from price discrepancies in circulars issued by central stations and those issued by manufacturers. W. F. Abely, Western Electric Company, Boston, suggested that in general advertising the price should be inserted at the option of the central station, provision being made for its insertion in all electrotypes of electrical conveniences.

The convention generally favored maintaining manufacturers' price in retail sales. Several speakers recognized that the present period of high prices is an opportune time to advance sales prices to a fair level of profit. C. R. Hayes, manager of the Fitchburg (Mass.) Gas & Electric Light Company, said that although gas appliances are to-day being sold at 65 per cent above cost, a rise above the former scale, no reduction in sales volume has occurred.

Closer co-operation from manufacturers relative to methods of selling their products was desirable, according to several speakers. It was the general opinion that the expenditure of say $75,000 in the co-operation of the manufacturers' advertising and sales specialties would produce more sales than the devotion of this sum to fifteen insertions in a well-known national weekly.

Wagner Electric Dividend Increases Outstanding Stock

Directors of the Wagner Electric Manufacturing Company, of St. Louis, have declared a special dividend of 80 per cent on the stock. Shareholders have the option of taking new stock at par or cash. The authorized amount of stock was increased recently from $2,000,000 to $5,000,000. The special dividend and the regular quarterly dividend of 2 per cent are payable April 2.

Commission Rulings

Important Decisions of Various State Bodies Involving or Affecting Electric Light and Power Utility Operation and Practice.

California Commission Considers Rates Charged by One Company to Another.—Rates charged by the Napa Valley Electric Company to the Calistoga Electric Company are under consideration by the Railroad Commission of California. Previously the Napa company charged the Calistoga company 2.4 cents per kilowatt-hour for electrical energy used for lighting and 1.75 cents for energy used for heating. After a hearing the commission made rates of 2 cents per kilowatt-hour for the first 15,000 kw.-hr. and 1.7 cents for all in excess of 15,000. The Napa company complains that these rates are unremunerative and asks restoration of the former schedule.

Division of Territory Ordered by California Commission.—The complaint of the Coast Counties Gas & Electric Company that the Sierra & San Francisco Power Company is illegally building, against the commission's order, a line in San Benito County to supply a consumer near San Juan Bautista, and also the application of the Sierra Company for authority to build this line and to sell energy in San Benito County under a franchise granted by that county, have been dismissed by the Railroad Commission of California. The commission directed the Sierra and Coast companies to submit a plan relative to service in the part of the county now served by the Coast company. The commission finds that the Sierra company should operate in part of the county under a franchise to be granted by the county and should be permitted to serve part, provided that it does not duplicate the facilities of any other electrical corporation in the district.

Duplicated Telephone Property Not Entitled to Return, Ohio Commission Says.—In an order issued on March 9 the Ohio Public Utilities Commission stated that property of telephone companies which is unused on account of duplication is not entitled to earnings. The case is that of the Lima Telephone & Telegraph Company. In July, 1916, the commission reopened its valuation, made as of Jan. 1, 1915, when it found the reproduction valuation to be $845,404, depreciation $144,686 and present value $700,718, and deducted the value of duplicate property found to be not used and useful. This property had a reproduction value of $109,528 and a present value of $56,621, according to the commission engineers. An allowance was made for betterments made between Jan. 1, 1915, and Aug. 31, 1916, and the value of the property actually used for the public was found to be: Reproduction, $768,655, and present, $677,222. The duplication came through the purchase of Central Union property. Following this, new rates were announced, effective on March 1, 1915. They were challenged by the city. The company insisted upon a valuation of $900,000, necessary to maintain a proper relation between the value and the outstanding securities. Under competitive conditions the independent company charged $36 for single-line business service and $30 for two-party service; the Bell rates were $42 and $27, respectively. After consolidation, the rates were advanced to $54 and $42, respectively. The commission finds that reasonable rates are $48 and $36, and that all collections in excess thereof since March 1, 1915, are unlawful.

Complaint Against Sale of Power by Los Angeles.—The Southern Sierras Power Company has filed with the Railroad Commission of California a complaint asking that the city of Los Angeles be compelled to apply to the commission for authority to do business in the territory about Owens Lake and to file a schedule of rates for that territory. Pending a final determination, the company asks that the city be restrained from contracting to supply the Natural Soda Products Company or the California Alkali Company for operating their manufacturing plants. Los Angeles built two generating plants near Owens Lake in 1907 to provide power for excavating the Owens River aqueduct. Since the completion of the work four years ago the city has been selling power in competition with the private company, according to the complaint of the latter and is now bidding for new business in competition. The complaint states that the city has not obtained a certificate of public convenience and necessity from the commission, as the company was required to do, and has never filed rates with the commission as public utilities must.

Public Utilities Commission of District of Columbia Modifies Accounting System.—An order has been issued on the application of the Potomac Electric Power Company for a modification of the methods of keeping the store expenses and the stable and garage expense accounts so as to permit the distribution of expenses included therein to the accounts that should properly carry such expenses. It appears that the stores and stable departments are maintained entirely for the use of construction work, either for new construction or for maintenance. It is very important that the items under discussion be considered in an entirely different light than the subject of general overheads. These expenses represent in great part charges that could be distributed to specific construction work, but in order to avoid the complicated bookkeeping involved, the company has suggested that such distribution be made on a percentage basis as outlined in the revised description of the accounts. It is the opinion of the commission that this method is not only proper but would result in much better accounting and would more clearly reflect the true cost of the various operations if the changes as suggested be permitted.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public-utility companies.

Remedy for Damages from Flowage.—The Supreme Court of Wisconsin held in McDonald vs. Apple River Power Company (160 N. W. 156) that since the power company was authorized to construct a dam in a river, it had the right, by law, to acquire flowage rights, and therefore the plaintiff, whose land was flooded by the water raised by the company's dam, had a remedy pursuant to the milldam act, so that it was an error to entertain the action against the company for damages from flowage as one in equity to abate a part of the company's flashboard used as a part of the dam. In such a case, the action need not necessarily be dismissed, but may be treated as a civil action, under the milldam act, to recover damages and the acquisition of flowage rights, with a trial before a jury to ascertain the company's liability.

Contributory Negligence in Jerking Street Lamp Chain.—Whenever a person walking along the street sees an arc lamp that has gone out, the first impulse is to vigorously pull the cord or chain by means of which the lamp is raised or lowered. Frequently such action has resulted in serious injuries and sometimes death to the person who pulled the cord. Such a case is discussed by the Supreme Court of Alabama in Bloom vs. City of Cullman (73 S. 85) in which a pedestrian was electrocuted by contact with a chain used to raise and lower such street lamps owned and controlled by the city. The court held that the degree of care resting upon a municipality operating electric street lamps, as to means of transmitting its electric current over public thoroughfares, is high and exacting, commensurate with the very dangerous agency employed. And, furthermore, that in the action for death of the pedestrian the burden of proving contributory negligence rests upon the city. In regard to the negligence of the deceased, the court stated that if a pedestrian on a public street, warned or having reason to know that a chain used to lower electric light was charged with energy from feed wires, carelessly touched the chain, he was negligent barring recovery for his death. If, on the other hand, he undertook to improve the light by shaking the chain, not knowing that the chain was charged, and having no knowledge that it would deter a reasonably prudent man from touching it, or if he had recently done so, or had seen others do so in safety, his touching the chain was not negligence barring recovery for his death. Whether such pedestrian's act was negligence depended on whether it was the act of a reasonably prudent man.

Arizona Power Contract.—F. S. Viele, president of the Arizona Power Company, reports that the company has made a contract with the Consolidated Smelting Company for a three-year term with a minimum of 1000 hp. It is expected that actually from 1200 to 1400 hp. will be used. This is about double the amount used at present.

Securities Acceptable Under British Mobilization Plan.—Consolidated Cities Light, Power & Traction Company first lien 5 per cent bonds have been added to the British treasury list of securities acceptable for deposit under the plan to mobilize securities. This action follows the inclusion of Cities Service Company preferred stock on the list, announced in July, 1916.

Low Cooking and Heating Rate in Uruguay.—Alan C. Towers, Montevideo, Uruguay, writing to the ELECTRICAL WORLD on low cooking rates, says: "It may be of interest to you to hear that the electric light company of this city (owned by the government) has just announced a new rate of 2 cents per kilowatt-hour for cooking and water heating. As coal in this city is costing at present between $25 to $30 a ton and as electric cooking has hardly been done at all in the past this ought to be a good opportunity to install electric ranges. The electric light has about 30,000 connected customers. I may add that 2 cents Uruguayan is about the same as 2 cents American money."

Water Power Legislation Recommended in New York.—In a report to the Legislature relating to the water power situation, Attorney General Woodbury of New York State suggests the desirability of a careful study of the problem. "The rapidly increasing cost of producing electrical energy by steam power," he says, "seems to emphasize the necessity for the development of all of the water powers of the State as rapidly as possible, in order that such electrical energy can be used instead of steam produced electrical energy, and thereby aid in the development of manufacturing and transportation enterprises which either now exist or which may easily come into existence as a result of such development."

Consumers in the Borough of the Bronx, New York, Ask That Rates Be Maintained.—The New York Public Service Commission, First District, recently had the unusual experience of consumers appearing to request that no reduction in rates be ordered as the result of an investigation being conducted by the commission regarding electric rates of the Bronx Gas & Electric Company. The investigation covers rates of both the Bronx Company and the Westchester Lighting Company, which, respectively, have maximum charges of 12 cents and 10 cents per kilowatt hour. The attitude of the consumers was based, they stated to the commission, upon their fear that if rate reductions were ordered and the company's income thus reduced, the company would find it impossible to make needed extensions of lines.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Electrolysis Survey Proposed in Montgomery, Ala.—The Bureau of Standards has been asked to make an electrolysis survey in Montgomery, Ala.

Power Commission Proposed for Maine.—A bill creating the Power Commission has been introduced in the Maine Legislature. It provides for investigation and utilization of such of the undeveloped water powers of the State as seem to be most advantageous.

Private Water Power Development Recommended by New York Conservation Commission.—The annual report of the New York State Conservation Commission to the Legislature says that the time has not arrived when the State should develop its water power to supply power for the people, but it should permit development by private means and take any revenues accruing over an adequate return to private investors.

Electric Products at Actors' Fund Fair.—Planned as a series of trade expositions in which electrical supplies will have a part, the Actors' Fund Fair, to be held at the Grand Central Palace, New York, from May 12 to 21, asks the co-operation of many important industries which are to be represented by donated merchandise. An attempt will be made to bring some return to business establishments for their generosity. A large section of the bazaar space has been set aside for the display of many varieties of electrical merchandise. Every opportunity will be offered for publicity through display cards, advertising literature, etc.

Customers' Information Books of Byllesby Companies.—The publicity department of H. M. Byllesby & Company, Chicago, has prepared customers' information books, electric, for practically all of the Oklahoma properties. Except for the rate schedules the material contained in the booklets has been standardized so that the booklets could be used to place in the hands of customers general information concerning service. The pages carry considerable educational matter. The following subjects are considered: The company's general policy, how to obtain service, function and duty of the sales department, service, advance deposits, pulmotor service, free fan and toaster service to indigent invalids, incandescent lamps, service trouble and adjustments, badges worn by employees, disconnecting and moving, electrical contractors, the meter as the company's measuring device, the basis of rates, electrical terms defined, rate schedules, and explanation of rates. "Personal Attention to Every Customer," is printed across the top of each page.

Wisconsin Campaign for Better Factory Lighting.—The Wisconsin Industrial Commission has inaugurated an educational campaign to secure better lighting in factories.

Annual National Household Gas and Electric Show at St. Louis, Mo.—Arrangements are being made by Manager Frank M. Robinson for the annual household show to be held at the Coliseum, St. Louis, March 19 to 31. The electrical department, under Miss "Kilowatt Kate," will demonstrate how cooking, baking and cleaning can be made a pleasure by means of the up-to-date contrivances.

Wisconsin Companies Combined.—The Eastern Wisconsin Electric Company, with an authorized capital of $10,000,000, has been incorporated in Wisconsin to acquire the properties of the Eastern Wisconsin Railway & Light Company, Fond du Lac; the Wisconsin Electric Company, Oshkosh, and the Sheboygan Electric Company. The president is Joseph H. Brewer, president of the American Public Utilities Company.

Public Utilities Commission Bill in Michigan.—A bill providing for the creation of the Michigan Public Utilities Commission has been drafted by Commissioners Glasgow and Kaiser of the Railroad Commission. Five commissioners, ten-year terms, and annual salaries of $6000 are stipulated. Departments are created, including one for gas and electric companies. An engineering and statistical bureau is included.

Commonwealth Edison Power Business Gains Rapidly.—From Jan. 1 to the middle of February, the power business of the Commonwealth Edison Company of Chicago amounted to about 11,000 hp., which is practically double the first six weeks of last year. A large proportion of this business came from concerns which are shutting down isolated plants. Among these are the Monroe building, with 400 hp.; Sherwin-Williams Paint Company, with a 1000-hp. turbine station; Gottfried Brewing Company, with 1000 hp.; Bauer & Black, with 800 hp.; the new Regan Printing Company building, with 700 hp., and, in addition, five new ice plants, making twenty-five artificial ice plants now electrically operated in the city.

Electrically Heating Cars in Unheated Garages in Detroit.—The Detroit Edison Company has made a number of tests with different methods of electrically heating cars stored in unheated garages. Various means of heating insulated and uninsulated garages have been tried and experiments made with nearly all of the heaters sold for heating the engine itself. The results of these tests are now being worked up, and they will probably be presented in a paper at one of the conventions during the coming summer. Means are available by which an automobile engine and appurtenances can be maintained at a temperature of 50 to 60 deg. Fahr. in a cold garage with electrically generated heat, at an expenditure of 1 to 2 kw.-hr. per night in the coldest weather.

March Meeting of the Electric Club of Toronto.—At the March 9 meeting of the Electric Club of Toronto, E. P. Heaton, provincial fire marshal, discussed "Fire Waste from Electric Causes." Frank T. Groome is secretary of the club.

Pittsburgh Section, A. I. E. E.—A. R. Cheyney, engineering department of the Westinghouse Electric & Manufacturing Company, addressed the Pittsburgh section of the A. I. E. E. on March 13, on the subject, "Power Limiting Reactances and Service Protection." F. E. Wynne is secretary of the Pittsburgh section.

Philadelphia Electric Company Section N. E. L. A.—On March 6 Robert Glendinning, a Philadelphia banker and aviator, spoke before the Philadelphia Electric Company's section of the National Electric Light Association on the progress which has been made in airplane construction and also regarding its application.

Electrical League of Cleveland.—W. W. Freeman, president of the Union Gas & Electric Company of Cincinnati, addressed the Electrical League of Cleveland on March 8, on the subject of co-operation. Paul M. Lincoln of the Westinghouse Electric & Manufacturing Company addressed the society on March 15. His topic was "The extent to which electricity has entered into our modern life."

Mercury Ell C. Bennett Addresses Houston Jovians.—Houston Jovians and guests gathered in the city auditorium on March 2 and heard a discourse on "Jovianism and Its Relation to the Electrical Industry," by Mercury Ell C. Bennett. Mr. Bennett, accompanied by representative Jovians from northern Texas, who have volunteered to escort him through the State, is engaged in the work of stimulating interest in the order among electrical people who have not yet become affiliated therewith. In addition, he is endeavoring to revive the enthusiasm of old members.

California Association of Electrical Contractors and Dealers. — At the monthly meeting of this association in Sacramento, Cal., on Feb. 24, a committee was appointed to bring to the next regular meeting of the association a definite recommendation for action on the trade-acceptance plan. Since a course in cost accounting is being conducted under the auspices of the University of California extension course, the secretary was directed to keep in close touch therewith to the end that accurate statistics in overhead costs, methods of accounting, etc., might be compiled and rendered accessible to association members. According to an announcement made at the meeting, the annual convention of the British Columbia Association of Electrical Contractors and Dealers will be held in Vancouver Aug. 20 to 25. Santa Rosa was selected as the city in which the California association would hold the annual convention for 1917. At the evening session short talks were made by M. A. DeLew, J. C. Holbrecht, D. E. Harris and A. H. Halloran.

Associations and Societies

A complete Directory of Electrical Associations is regularly printed in the first issue of each month on the next-to-last text page.

Institute of Radio Engineers.—"The Determination of the Audibility Current of a Telephone Receiver" was the subject of an address by Prof. Edward W. Washburn of the University of Illinois before the Institute of Radio Engineers, New York City, on March 7.

Toronto Engineers Visit Telephone Exchanges.—W. J. Clarke, plant superintendent of the Bell Telephone Company, piloted members of the Toronto section of the A. I. E. E. through the Adelaide and Main exchanges of the Bell Telephone Company on March 2. Wills MacLachlan is secretary of the Toronto Section.

Chicago Meeting—A. I. E. E.—The 330th meeting of the A. I. E. E. was held in Chicago on March 9 and 10 under the auspices of the Chicago section and the protective devices committee. The morning and afternoon of the first day was devoted to various committee meetings, to a number of inspection trips, and to a board of directors meeting. A technical session was held at night, the general subject of the session being "Methods of Relay Protection." The papers presented are discussed on page 508 of this issue under the heading, "Relay Practice of Larger Systems."

San Francisco Section, A. I. E. E.—At a meeting of the San Francisco Section of the American Institute of Electrical Engineers, held on Feb. 23, W. A. Hillebrand presented an illustrated paper on "The Maximum Demand Meter." The paper contained the results of an exhaustive study of problems involved in measuring current under varying demand conditions. Discussion on the paper indicated agreement on the point that the meter problem is not yet solved, that rate making is in advance of meter manufacture and that an urgent demand now exists for a meter that will answer the demands of service.

Association of Iron and Steel Electrical Engineers.—The regular monthly meeting of this society was held to-day (March 17) at the Fort Pitt Hotel, Pittsburgh, Pa., the electrical development committee presenting papers on the latest practices in the application of electricity to the iron and steel industry. S. C. Coey is chairman of this committee. The next meeting of the Pittsburgh section will be held April 21 under the auspices of the standardization committee, of which W. T. Snyder is chairman. The next meeting of the Philadelphia section will be held at the Majestic Hotel, April 7. Karl A. Pauly of the General Electric Company will present a paper entitled "Variable Speed Control of Alternating-Current Motors."

Cleveland Electrical League.—At the regular weekly meeting on March 1 the league showed the patriotism of its members by sending telegrams to their representatives in Congress, asking them to neglect no means or measures that will uphold the honor and dignity of the United States. Dr. Charles S. Howe, president of Case School of Applied Science, addressed the 225 members present on "Undeveloped Sources of Power," and under this head considered the possible development for commercial purposes of electric energy through the use of the tides, waves and the sun.

E. N. Hurley Speaks on Business Problems at Chicago.—At the meeting of the Electric Club-Jovian League of Chicago, on March 8, E. N. Hurley, ex-chairman of the Federal Trade Commission, said: "With central stations rapidly developing their efficiency along the lines of familiarizing themselves with their actual cost, which enables them to give service at reasonable rates, it is necessary that the manufacturers, jobbers and retailers in the electrical industry also be keenly interested in the development of better methods of doing business. They also should aim to give service and realize that they must cooperate and organize along sound, practical lines, so that they may be able to sell their product at a reasonable figure. It is recognized that a business man must be concerned not only with the efficiency of his own business but with the efficiency of his competitor's business, and realize that unhealthiness anywhere in his industry will react seriously on him. I predict that within five years there will be very little money loaned by any banker in the United States to any merchant or manufacturer who does not present a statement showing detailed information not only regarding his true assets and liabilities, but also indicating that he is conducting his business in an efficient manner and that he absolutely knows what his true costs are.

"One of the real needs among American business men to-day is a broad view of business and a comprehensive grasp of industry as a whole. The men who realize this principle, who are studying our economic problems from this point of view, are the men who will do the big things and be the real leaders of American business. The problems now before the business men and government are not so complicated but what they can be worked out, and in a reasonable length of time. The Government has shown that it is willing and anxious to co-operate with business. It is now the duty of the business men of this country to do their part. Successful co-operation requires a friendly spirit on both sides, if we are to accomplish real constructive work. When business men request advice in advance as to some particular step they wish to take, they should present to the government an intelligent statement of the facts; then the government should give advice in advance as to what busines men should or should not do. This applies to legal questions, as well as to economic ones."

JULIAN C. SMITH

Julian C. Smith, who was recently awarded the Gzowski medal of the Canadian Society of Civil Engineers for his part of a paper on the Cedars Rapids Manufacturing & Power Company's development, is one of the youngest and best-known engineers in the province of Quebec. He is a member of the British Institution of Electrical Engineers and of the Canadian Society of Civil Engineers and a fellow of the American Institute of Electrical Engineers. Besides being general manager of the Shawinigan Water & Power Company, Mr. Smith is connected with the many subsidiary companies as executive officer or director. He was born at Elmira, N. Y., 1878, and was educated at Cornell University. After taking the degree of mechanical engineer in 1900, he began work as a draftsman with Wallace C. Johnson, consulting engineer at Niagara Falls, N. Y., where he remained two years. He subsequently became assistant engineer to Mr. Johnson at Shawinigan Falls, Quebec. In 1903 he was made superintendent of the Shawinigan Water & Power Company of Montreal and in 1906 was advanced to general superintendent becoming general superintendent and chief engineer in 1909. The Shawinigan Water & Power Company operates the largest generating system in the province of Quebec and is now delivering power to all of the larger cities and towns in the province. Taken in connection with the Cedars Rapids Manufacturing & Power Company, operated by the same interests, and the Laurentide Power Company, the output of which is purchased by the Shawinigan Water & Power Company, the generating system over which Mr. Smith exercises both engineering and managerial supervision is the largest in the Dominion of Canada. The developments are all new and represent the largest hydroelectric work undertaken within the last few years in the whole of North America. Besides taking a keen interest in engineering societies Mr. Smith has made numerous contributions to engineering literature. He was awarded the Gzowski medal in 1913 also for his paper on "Design of High-Voltage Transmission Lines" covering the new Shawinigan-Montreal line.

Men of the Industry

Changes in Personnel and Position— Biographical Notes

W. F. Anderson, former superintendent of the Effingham Waterworks Company, has been appointed secretary and general manager of the Eastern Illinois Utilities Company at Effingham, Ill., succeeding W. G. Austin, who has resigned.

W. G. Austin, who for the past twenty years has been connected with the Effingham electric plant, has resigned from the position of secretary and general manager of the Eastern Illinois Utilities Company at Effingham to take charge of personal business interests.

M. J. Healy, formerly in charge of the meter department of the Lockport (N. Y.) Light, Heat & Power Company, has been appointed commercial manager of that property.

H. M. Kohn, for the past year commercial manager of the Birmingham (Ala.) Railway, Light & Power Company, has resigned his position with that company and will enter business for himself in Birmingham.

Walter Neumuller is starting on an extended tour of the country in connection with the systematic membership campaign inaugurated by the membership committee of the National Electric Light Association, of which he is chairman. His itinerary will take in as far west as the Pacific coast and will bring him in touch with the greater part of the central station industry

WALTER NEUMULLER

of the United States. While the National Electric Light Association includes in its membership 90 per cent of all the central station companies in the country, representing an investment of approximately $3,000,000,000, there still remains a considerable number of companies, especially in the smaller cities, which have not availed themselves of the benefits of affiliation with that organization.

C. S. COOK

C. S. Cook manager of the railway and lighting department of the Westinghouse Electric & Manufacturing Company at East Pittsburgh, on March 1, was selected as general manager of the Duquesne Light Company to fill the vacancy created by the death of Robert S. Orr. Mr. Cook was born in Massachusetts, educated at the Worcester Polytechnic School, from which he graduated in 1887. He was first employed in the old Westinghouse Electric Company's plant in 1887. At that time the electric company shared a very small building in Garrison Alley with the Union Switch & Signal Company. Mr. Cook served in the shops and testing room and in 1888 was made construction engineer of building, lighting and power plants. In 1889 he became engineering superintendent of construction in the Chicago office, and in 1895 he returned to Pittsburgh to take charge of special sales engineering work in the Pittsburgh district. In 1899 he became manager of the Pittsburgh office of the Westinghouse Electric & Manufacturing Company, which position he retained until 1904, when he assumed the position at East Pittsburgh from which he has just retired. In this department he had control of all commercial operations relating to power machinery for public service corporations.

A. P. Ramstedt, former president of the Public Utilities Commission of the State of Idaho, has resigned as a member of the commission to accept the position of general auditor and comptroller of the Day Mining interests, including among others, the Hercules Mining Company, Tamarack & Custer Consolidated Mining Company, and other mining companies in Idaho and British Columbia; the Northport Smelting & Refining Company at Northport, Wash.; Pennsylvania Smelting Company at Pittsburgh, Pa., and various banking interests in Idaho and Washington.

Trav Smith, for the past six years assistant manager of the light and water department of Elberton, Ga., has been elected to the position of superintendent of light and water at Toccoa, Ga.

REVIEW OF TRADE AND MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

MANY GLASS MAKERS FORCED TO SHUT DOWN PLANTS

Weather Conditions in the Natural Gas Fields Are Worse Than Usual—Higher Prices Are to Be Expected

Owing to the unusual weather conditions that have existed lately in the natural gas fields a large number of glass makers have been forced to close down their plants, some of them entirely. All who have been dependent upon natural gas for fuel have suffered to a great extent this winter. Those who have not had to shut down their plants have had to curtail operations considerably. Conditions this year were fully 50 per cent worse than ordinarily.

There is reason to expect, therefore, that in the near future another rise can be expected in the price of electric glassware. Prices on window glass went up last week to the extent of 15 per cent, and it is not unreasonable to suppose that electric glassware will advance fully as much.

With a production greatly curtailed and with the congested conditions of freight terminals and the shortage of rolling stock, jobbers' stocks of electric glassware, never very large, have been seriously depleted.

CREDIT CONDITIONS IN THE ELECTRICAL TRADE

Collections Larger at Present than Ever Before—Industrial Plants Borrowing Heavily from Banks on Short-Term Notes

Credit conditions are probably better to-day in the electrical industry than they ever have been. General business is better, everybody is busy and earnings are increasing, money is easy and plentiful, with the result that buyers are paying their bills promptly. Reports from different sections of the country indicate that the daily collections in January and February of this year set a new high record.

There is no doubt but that credit managers have generally exercised more care in extending credit in the past year and a half. The market has been distinctly on the sellers' side and he therefore has been in a position to dictate terms as favorable to his business as he could wish. In a number of cases sellers have taken advantage of the general business situation to shorten up the time of credit.

On the Pacific coast there is a notable tendency to shorter terms on which credit is extended by jobbers, and to bring cash discounting down to a ten-day limit instead of the usual thirty-day terms.

The fact that business is being selected by the seller with greater care is also reflected in the state of business among commercial lawyers. They complain that their business has fallen off 50 per cent. One electrical firm doing a business in the Middle West running into millions of dollars is said to have had losses in 1916 amounting to only $96.

As a result of the fact that for some time increased caution has been exercised in the extension of credits, dealers and contractors on the Pacific coast have found it necessary to keep business affairs in better shape in order to secure desired credits. This, coupled with the co-operative and educational movement that has been noted on the coast of late, has materially improved the general business situation among dealers and contractors.

The feeling is that a much more healthy condition results when the man who is entitled to a certain amount of credit for a certain time is required to keep within both sum and time. Until comparatively recently, conditions in this regard have been neglected somewhat by the manufacturers, or at least they were not rigidly enforced. The present tendency is to come back to the strict interpretation of terms, and this is regarded as having a very healthy effect upon credits and collections.

Among manufacturers a strict watch over the affairs of industrial plant customers is maintained now for signs of over-expansion. These concerns have been found prone to buy beyond their logical limit on a rising market. This is discouraged. A study of industrial company statements such as are regularly made at this time of the year shows a considerably greater debt. It is practically all of the short-term variety and represents cheap money borrowed from the banks for a few months to pay for supplies and materials against earnings. So long as earnings keep up, this situation will probably provoke little more than comment. These statements are being carefully watched by credit men and should it become evident that industrial concerns are borrowing too heavily and taking too great a chance some action will undoubtedly be taken to produce a safer margin between debt and anticipated earnings.

The uncertainty regarding the probability of the United States engaging in hostilities with Germany still has a grip on the market, although it is not so apparent as it was a month or two ago. In placing contracts some buyers have taken the precaution to stipulate different arrangements for payment in the event of this country entering the war. There is some belief that collections would be still larger were it not for the uncertainty about the future action of this country. In Texas especially has this been noticeable.

Trade acceptances are continually finding a wider use in the electrical industry, more so, however, by jobbers than by manufacturers.

In Portland, Ore., the trade acceptance plan has been put into effect and the use of thirty-day acceptances is being tried. On these terms the purchaser really gets sixty days' credit; that is, January purchases are paid for in the middle of March. There are also being used on the coast a few sixty-day acceptances, which means an actual credit term of ninety days. The trial of this system is in the nature of a substitute for the four-month term, which has heretofore been the usual accommodation.

Some changes are said to be needed in the trade acceptance plan as now being tried in the Northwest, and these will probably be effected before the plan spreads into more general use along the Coast. It is agreed by several jobbers, however, that the trade acceptance plan will likely be used throughout the West Coast before long. The point is made that the jobber operates on narrower margin and therefore should secure shorter terms than other interests in the electrical field. This points to the jobber as the agency through which the trade acceptance plan would most naturally be introduced.

The general tie-up in east-bound railroad traffic and the consequent embargoes has caused a number of manufacturers to make a change in the method of handling foreign credit. Formerly a foreign customer was billed f.a.s. New York cash on receipt shipping documents. With the scarcity of bottoms, tie-ups, embargoes, delays in delivery, it is apt to be a long time after the goods have been manufactured before they actually leave the United States. For these reasons some manufacturers have begun to bill foreign consumers f.o.b. factory, cash on receipt bill of lading. This method, while by no means general, is being used rather widely by large American exporting corporations.

An attempt at the classification of buyers as credit risks under the existing conditions brought out that the large industrial plants and railroads and the municipalities are considered the best risks. Just now the first-named class are considered exceptionally good risks and prompt pay.

The municipalities, while they are a trifle slow at times, are considered gilt-edged risks. Most manufacturers and jobbers who expressed opinions placed central station companies third on the list of desirable credit risks, largely because of the long time they sometimes take in meeting bills. The electrical contractors are still the least desirable, and from year to year it is difficult to see much improvement in them. Taken over a period of years, however, educational efforts in this direction can be seen to be taking effect.

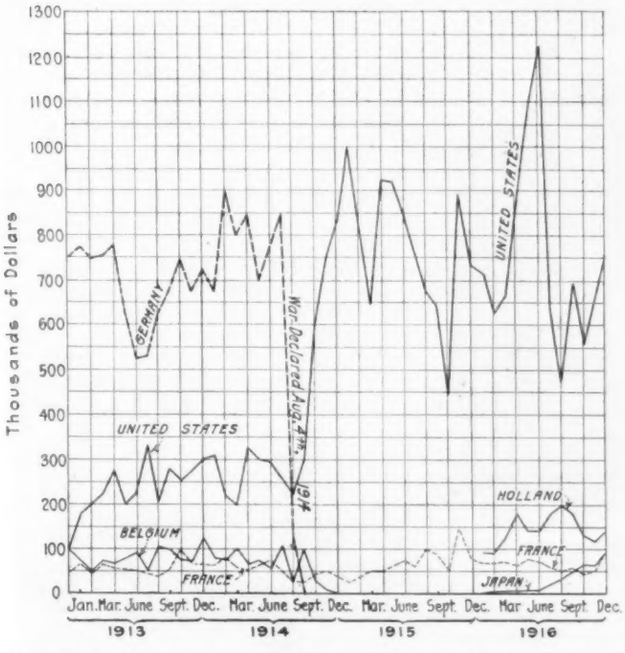
No one seems pessimistic regarding the future. So long as war is averted there seems to be a consensus of opinion that collections will keep up. A good many concerns that formerly required long credit terms are now taking advantage of discounts, paying from earnings. That earnings should be so large and continue so is put forth as a reason for expecting the immediate future to hold up. Indications so far are that the collections for March will be very large.

It is recognized, of course, that the tide will turn and that collections will slow up some day. But the belief is that this will not be during the present year. With the slow and unsatisfactory accounts reported to the Electrical Credit Association falling off both in number and amount of money represented, with the present tremendous momentum of business, and with at least a year of "reconstructive period" to look forward to even after the cessation of the European war, no breakers are seen immediately ahead.

AMERICAN ELECTRICAL GOODS IN BRITISH MARKET

Over 60 Per Cent of Electrical Material Imported Into United Kingdom in 1916 Manufactured in the United States

During 1916 the imports of electrical goods into the United Kingdom were valued at $13,650,000, as compared with $13,250,000 in 1915, $13,850,000 in 1914 and $14,750,000 in 1913, according to a compilation made by the *Electrical Review* of London. In 1915 France and the United States



MONTHLY IMPORTS OF ELECTRICAL GOODS INTO GREAT BRITAIN, SHOWING RELATION OF AMERICAN GOODS TO THOSE OF OTHER COUNTRIES

were practically the only exporters of electrical goods to England in any large quantity, French goods forming roughly 10 per cent of the British electrical imports. Last year, however, Dutch and Japanese goods began to enter the British markets in considerable volume. The Dutch merchandise, which amounted to about 12 per cent of the total imports, was over 90 per cent incandescent lamps. French goods representing about 6 per cent of the total imports showed a smaller total than in 1915. Three per cent of the imports were from Japan, and while the total was not large, nevertheless the quickness with which Japanese electrical goods established a footing in the British market has been very noticeable.

American goods constituted roughly 63 per cent of the British electrical imports in 1916, a high point being reached in June with a total of over $1,200,000. The total 1916 figures, however, are less than those for 1915. In 1916 the total American electrical goods imported into the United Kingdom was roughly $8,500,000, as compared with $9,275,000 in 1915, $4,500,000 in 1914, and $3,000,000 in 1913.

Prior to the war over half of Great Britain's electrical imports were of German manufacture. In a large measure, but not entirely, has this market been absorbed by American manufacturers.

While the 1916 imports of American goods showed a decrease in value of practically 8.5 per cent over 1915, the actual decrease was probably much larger owing to the greatly increased value of electrical goods in 1916. A considerable part of the decrease can be attributed to the import restrictions placed on a number of domestic appliances by the British government.

It is quite true that the demands of the British market on American manufacturers was much larger than is indicated by the 1916 figures. The domestic market, however, was so great and the factories so crowded with work that much of the foreign business had to be refused. In addition the price and delivery of American goods were frequently prohibitive. A by no means inconsiderable part of the Japanese electrical trade with Great Britain, it is known, can be attributed to this latter cause.

CONDITIONS IN COPPER MARKET REMAIN UNCHANGED

Market Still Quiet, Although Sellers of Second Quarter Metal Make Offerings with Greater Freedom

Copper prices remain practically unchanged over the week in a market that is still quiet. There has been a greater freedom of offering of second quarter copper manifested during the past week than has been evident since the beginning of the current year. In fact, the trade is by no means convinced, now that so much nearby copper is being offered for sale, that the supply has been sold up as tightly as has been reported. There seems good reasons to believe that buyers, by paying the price, can procure substantial amounts of nearby copper.

Nominal prices as quoted on Tuesday last for electrolytic were as follows: March shipment, 36.25c.; April 36.5c.; second quarter, 34.5c.; third quarter, 31.5c.; fourth quarter, 30.5c.

NEW YORK METAL MARKET PRICES

	Mar. 5 Selling Prices Bid	Mar. 5 Selling Prices Asked	Mar. 13 Selling Prices Bid	Mar. 13 Selling Prices Asked
Copper	£ s d		£ s d	
London, standard spot	139 0 0		136 0 0	
Prime Lake	35.00	to 36.20†	35.00	to 36.00†
Electrolytic	36.00	to 36.50†	36.00	to 36.50†
Casting	33.00	to 33.50†	32.00	to 32.50†
Copper wire base	42.50	to 43.50†	42.50	to 43.50†
Lead	9.00		9.00	
Nickel	50.00		50.00	
Sheet zinc, f.o.b. smelter	21.00		21.00	
Spelter, spot	10.80	to 11.05	10.82½	to 10.92½
Tin, straits	53.75		53.37½	
Aluminum, 98 to 99 per cent	53.00	to 55.00†	53.00	to 55.00†

OLD METALS

Heavy copper and wire	28.50	to 29.50†	28.50	to 29.50†
Brass, heavy	17.50	to 18.00†	17.50	to 18.50†
Brass, light	14.25	to 14.75†	14.25	to 14.75†
Lead, heavy	8.00	to 8.50†	8.25	to 8.75†
Zinc, scrap	7.75	to 8.00	7.75	to 8.00†

COPPER EXPORTS

Total tons to Mar. 13 12,506

†Nominal.

NEW APPARATUS AND APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Automatic Pole-Type Constant-Current Transformer

An automatic pole-type constant-current transformer that requires practically no care or attention after it has been properly installed is shown in the

WEATHERPROOF AUTOMATIC CONSTANT-CURRENT TRANSFORMER FOR POLE-MOUNTING

accompanying illustration. For indoor use, this transformer is constructed for mounting on the station wall or ceiling if floor space is at a premium. One feature of this type to which the maker calls attention is that the transformer can be operated by an oil-immersed time switch. The transformers also regulate as close and through as wide a range as the best type CC station transformer made by this company. The current from full load to no load is maintained within 1 per cent of normal. The efficiency is the same as for the station-type transformer and the power factor is high.

Several advantages are claimed for this transformer. For instance the high initial reactance serves to protect lamps connected therewith when first energizing and serves instantaneously to check surges on the line which would shorten lamp life. The moving secondary coil with its high repulsion force gives almost perfect regulation from full load to "dead" short-circuit. It not only protects the lamps from changes in current due to changes in secondary load but also protects the lamp from fluctuations in primary voltage.

Since the theory of operation is identical with that for the station-type constant-current transformer, the design differs only in the construction employed to make the transformer automatic. A tap is provided in the 2300-volt primary winding so that the transformer will carry full load and regulate satisfactorily when operated on a 2000-volt circuit. In addition, the 2300-volt transformer is designed so liberally that it will give good regulation on a 2400-volt circuit. These transformers have an ultimate temperature rise by resistance not exceeding 55 deg. C. based on a surrounding temperature of 25 deg. C. The transformer is a recent product of the General Electric Company, Schenectady, N. Y.

Mammoth Radiator-Type Regulator

In the accompanying illustration is shown the largest self-control induction feeder voltage regulator that has

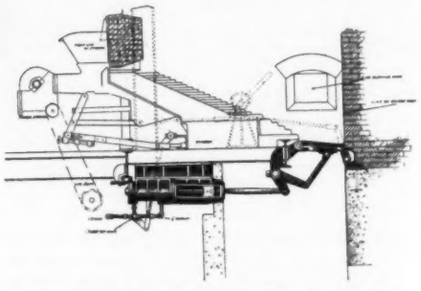
INDUCTION FEEDER VOLTAGE REGULATOR RATED AT 600 KVA.

ever been built. The regulator, which is of the oil-insulated, self-cooling type, was made by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa. It is rated at 600 kva., three-phase, 60 cycles, 13,200 volts, with 10 and 20 per cent regulation at 262 and 131 amp. respectively. The regulator is designed for operation outdoors with full-automatic control self-contained. It was built for the Southern Power Company and is to be connected to the low-voltage side of a 6000-kva. bank of 44,000/13,200-volt transformers on the power company's line at Spray, N. C. By the use of this regulator power will be delivered to the Thread Mill Company's mills owned by the Marshall Fields interests, at constant voltage.

Steam-Operated Dumping Plate for Stoker

The dumping plate shown in the accompanying illustration is operated by a steam cylinder located underneath the stoker. The dump plate is hinged so it will operate as a single unit. At its free edge the plate is supported by a series of pawls set directly in the bridge wall, to prevent sagging under load. By rocking these pawls, the dump plate is dropped. Opening a steam valve will raise it not merely to its normal position but considerably higher. Regardless of the rate at which the boiler is operated, the complete process of dumping, including the removal of clinker, can be performed in a relatively short time, possibly twenty seconds on an average, because the dump plate is comparatively wide from back to front and because slag does not adhere readily to the bridge wall just above the dump plate and reduce the effective area of the discharge opening. Furthermore, clinkers are scraped off at every dump by the action of the dump plate. With ample steam power to operate it, the dump plate can be made as heavy as desired. It is deeply ribbed to assist radiation, and to minimize warping and consequent need of renewal.

The control apparatus is located by the side-wall door, or elsewhere if desired, suitable linkages being run to the rocker shaft carrying the pawls on which the edge of the dump plate rests, and to the three-way valve actuating



DUMP PLATE DROPPED FOR DUMPING

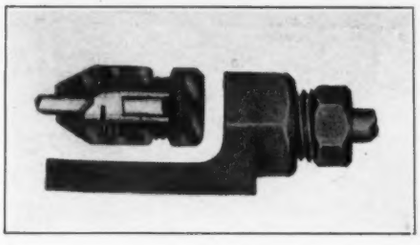
the steam cylinder. The pawls are rounded, so they do not have to lift the dump plate before releasing it. In dumping material collected on the plate the pawls are rocked and the dump plate allowed to drop. If the fuel con-

tains little or no clinker, no other operation is required. To raise the dump plate the steam valve is opened, the pawls are rocked again, and the dump plate is lowered on them by cutting off the steam. The whole operation takes five or ten seconds.

If the fuel contains clinker, as most soft coals do, part of the clinker forms big porous masses on the dump plate and lower grate, which tend to adhere and "hang" when the ashes are dumped. Part of the mass existing as liquid particles is thrown against the face of the bridge wall, down which it runs, to harden on the brick just above the dump plate. This is easily removed however, as the heavy dump plate, with ample steam behind it, acts as a hammer and scraper when raised above its normal position. A second blow may be delivered, but it is rarely necessary. Since the crust is formed between dumps, or say during a period of four or five hours, it is usually porous and is confined to a narrow band in easy reach of the dump plate. Raising the dump plate has another result. It loosens and tends to crush the clinker masses on the dump plate and lower grate. If some of these have escaped the first fall of ash, they are detached by the upward movement of the dump plate, and are carried down by dropping it again. Since the clinker can be kept loose in this way air can always reach the combustible on the lower grate, and there no unburned residue is liable to remain in the ash. This power dump is embodied in the Taylor stoker manufactured by the American Engineering Company of Philadelphia, Pa.

Solderless Connectors

Solderless connectors manufactured by the Fargo Manufacturing Company of Poughkeepsie, N. Y., for joining solid or stranded wires and cables are shown in the accompanying illustration. These connectors are used for splicing conductors of all sizes end to end, and forming a cold-weld solderless connection. The type shown on top grips the wires, cables or solid rods the full length of a 15-deg. taper and is firmly compressed about them. The conductors are held in place by a nut with a 15-deg. taper which insures a good contact



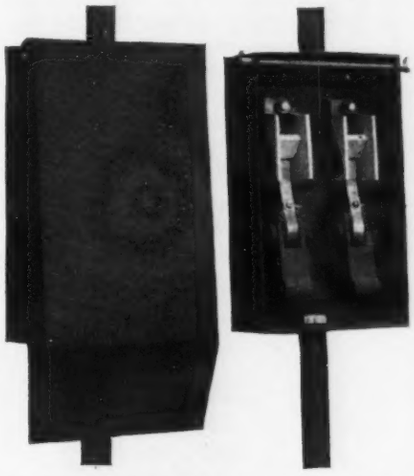
TOP—TWO-WAY SOLDERLESS CONNECTOR; BOTTOM—TERMINAL SOLDERLESS CONNECTOR

over its entire surface.

Terminal connectors like the one shown on the bottom are made for connecting cables and wires to flat busbars or front-connected switches.

Double-Pole Main-Line Switch for Elevators

The Warner Elevator Manufacturing Company of Cincinnati, Ohio, has developed a double-pole main-line switch to be used in connection with its elevators. Two of the switches are intended for installation in the elevator hatchway—one at the top and the other at the bottom. Energy delivered to the elevator machinery passes through the switches in series, so that in case either switch is opened the power supply is cut off from the elevator motor. The switch is inclosed in a covered iron box, the lid of which is cam shaped and is so placed that it engages with a corresponding cam or shoe on the elevator car. In case the car overruns, either at the top or bottom of the hatchway, the shoe on the car forces the lid inward, thereby opening both poles of the switch. The contacts are of the metal-to-metal shoe



LIMIT SWITCH THAT PREVENTS ELEVATORS FROM OVERRUNNING

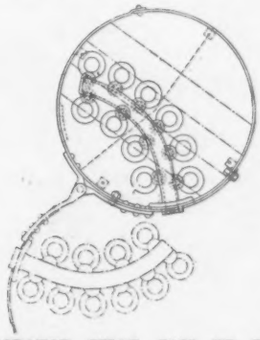
type, having a rolling slide action. Magnetic blow-outs are provided.

While the wiring for this type of limit switch is more expensive than that required for small pilot switches used in conjunction with circuit breakers, this switch has the advantage that it is absolutely positive in action. The switch is especially suitable for alternating-current equipments, because it is noiseless. The switch consumes no energy while the elevator is idle.

Water Evaporator

An evaporator which is said to provide a supply of distilled water for boiler feeding, drinking, culinary and such other purposes has been developed by Row & Davis, Engineers, Inc., 90 West Street, New York City. The apparatus consists of a shell with a door, to which is attached manifold and heating coils, the heating element also being mounted on a hinged door, which enables it to be swung outside for convenient inspection, cleaning or repair. This construction eliminates the necessity for supporting rollers, tracks or other handling devices. The position of coils forms an ebullition compartment without the use of baffles and permits complete circulation without conflicting currents. A simple but effective form of baffle in the top of the vapor space is said to eliminate all possibilities of priming.

The cylindrical shell and its concave and convex heads are made of open-



EVAPORATOR THAT CAN BE EASILY CLEANED

hearth boiler steel or cast-iron, as specified. The top and bottom manifolds for steam inlet and condensation drain respectively are similar and consist of cast iron or bronze bolted to the door. The coils are made of seamless drawn copper and are helical in form so that practically no stress is exerted on the joints. This construction permits the scale to be removed by suddenly flooding the evaporator with cold water and blowing down at intervals, the expansion and contraction stresses within the coils loosening the scale. The joints between the coils and manifold are made by slightly flaring the tube end and locking it between a tapered nipple on the manifold and a corresponding brass bushing. The latter is made secure by screwing it into a brass lock nut that in turn screws onto the nipple. Where a flanged joint is preferred to a locked one, the lock nut can be replaced by a pair of two-bolt flanges.

Rust-Proofing Material and Method of Using

"Eppicassit," a rust-proofing material sold by Hess & Son, 1033 Chestnut Street, Philadelphia, Pa., consists of a powdered metal, usually either tin, lead, zinc or their alloys. After the powder is mixed with a suitable fluxing carrier to the consistency of a smooth, creamy paint, the article to be treated is well cleaned and the paint applied thereto. Heat is applied to melt the coat down.

The cold paint may be applied with a brush, just like ordinary paint, or the article may be dipped into it, drawn through it or tumbled into it. Heat may be applied to the coating in whichever way is most convenient. Cold painted articles may be placed on shelves or on racks in an oven, similar to an enameling oven. Small articles may be placed in heated tumblers that are stationary, until the coating is melted down and then tumbled to prevent sticking. Tanks, etc., that are made of leaded or galvanized sheets and that are too large to be dipped are rust-proofed where exposed by applying the protective coating with a brush and melting it with a blow torch.

Overfeed V-Type Stoker

The V-type stoker shown in the accompanying illustrations is the latest development which the Detroit (Mich.) Stoker Company has made in the overfeed inclined grate type of stoker.

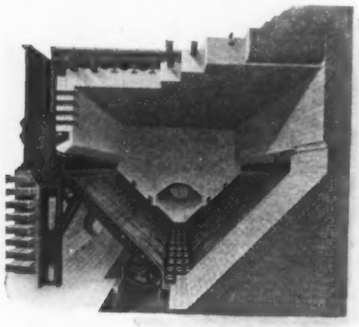


FIG. 1—REAR VIEW OF "V"-TYPE STOKER AND FLAT SUSPENDED ARCH

Among the special features claimed for this stoker is the exceedingly large coking surface, which extends the full length of the furnace on each side and under the firebrick arch, producing an even distillation of the gases at a high temperature and eliminating the smoke. The stoker is operated on natural draft, which eliminates the necessity of fans or blowers and does not subject the stoker to a shut-down due to the failure of any of the auxiliary appliances. The steam required for the operation of the stoker is said to be less than 1 per cent of the total amount generated in the boiler, and this is one of the causes of its low operating cost.

In connection with this stoker the manufacturer has recently developed the Detrick flat suspended arch, which is said to have several advantages over the old type of sprung arch. Although the first cost is considerably more than for the sprung arch, the lower maintenance cost will offset this disadvantage, it is claimed. The suspension is of the pendulum type and permits of free expansion and contraction, which eliminates stresses and strains common to some types of arches. Repairs or renewals to the arch are easily made by replacing as many tiles as are necessary without disturbing the remainder of the arch. The side walls below the

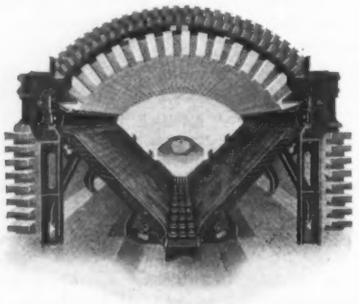


FIG. 2—REAR VIEW OF HEAVY-DUTY "V"-TYPE STOKER WITH SPRING ARCH

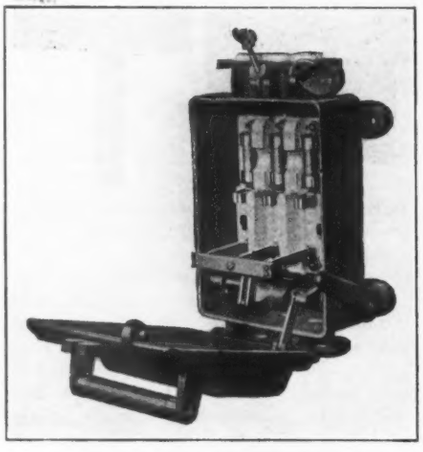
arch can be replaced or repaired without disturbing the arch or any of the iron work. The supporting beams and hangers are ventilated by the air, which is admitted through the stoker fronts, passing between the arch tile and the arch roof, thus preventing them from overheating.

Buckstays are not required, there being no side thrusts, as the whole weight of the arch rests on the stoker iron work entirely independent of the brick work. With this type of arch it can be placed at any height to supplement the boiler baffles in forming an unrestricted path for the travel of the gases. After being drawn in through the stoker fronts the air passes downward through the tuyere openings, where it mixes with the gases distilled from the coal. This mixture of combustible gas which, coming in contact with the highly incandescent furnace arch, is completely burned.

Coal is stored on top of the stoker and feeds by gravity through the magazine on both sides to the grates. The fuel bed moves down toward the center of the furnace and the ash and clinker are ground through the clinker crusher and drop into the pit below. The continuous movement of the vibrating grates and the constant operation of the clinker crusher keep the fire clean.

Fused Switch Boxes

Switch boxes particularly adapted to 250-volt, direct-current mill service have been brought out by the D. & W.



COMBINED SWITCH AND FUSE BOX

Fuse Company, Providence, R. I. They may be permanently locked after the fuses are installed, thereby preventing any tampering with the connections or increasing the capacity of the fuses. The circuit can be opened or closed at will without opening the cover by moving the lever at one side of the box. By referring to the illustration, it may be seen that when the cover is opened, the circuit is likewise opened. This arrangement makes it impossible to refuse the circuit when the switch is closed. These boxes are provided with rubber gaskets, which make them waterproof provided the terminal wires are taped at the bushings or protected by outlet hoods when conduit connections are made. To facilitate installing these boxes, removable porcelain bushings may be used through which the cable terminals may be readily passed.

Straight Connector

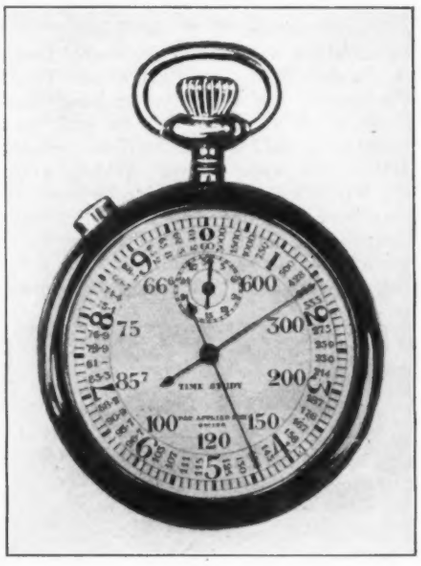
A straight connector that is simple and makes a firm twisted joint has been developed by the Fargo Manufacturing Company of Poughkeepsie, N. Y. The air space has been made as small as possible, while the area of

METHOD OF USING STRAIGHT CONNECTOR

contact is large. The large contact surface, together with twisting the wires, forms a joint of low resistance. This connector is made for wires of sizes ranging from No. 4 to 14. In the accompanying illustration is shown the method of using this connector.

Motion-Study Watch

The watch shown in the accompanying illustration has been brought out by Mortimer J. Silberberg, 122 South Michigan Avenue, Chicago, Ill., and is said to be an improvement on previous time-study watches and stop watches, in that a dial calibrated in decimals of a minute has been combined with a high-grade split-hand watch. The dial figures are spaced 0.02 of a minute apart, so they will indicate exactly what the corresponding hourly production would be after any elapsed period of time. With this arrangement both the productive and non-productive time of an operation can be obtained in one observation, whereas on single-hand instruments two readings are said to be neces-



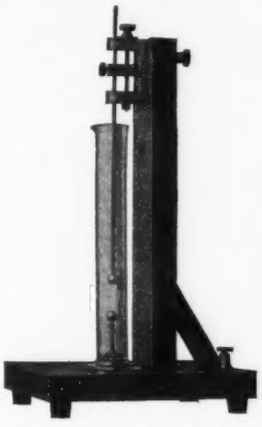
SPLIT-HAND MOTION-STUDY WATCH WITH DECIMALLY DIVIDED DIAL

sary to obtain this result. Of the two hands one is controlled by the side plug and the other by the crown, or if it is desired to use both as a unit, both hands may be controlled by the crown. The crown-controlled hand may be used to

determine the gross time, and the plug-controlled hand to deduct the non-productive time, or delays, thereby at one reading giving an observer both the gross and net time required for an operation.

Oil Testing Cup

The oil testing cup shown in the accompanying illustration consists of a graduated glass cylinder containing two testing terminals, each a brass sphere



CUP FOR MAKING DIELECTRIC TESTS OF OIL

0.5 in. in diameter. The outfit has been placed on the market by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., for convenience in making dielectric tests of insulating oil. The upper sphere may be moved up or down by hand or engaged with a micrometer screw for making fine adjustments of the gap. All parts are readily accessible for cleaning, and the zero point of the gap may be quickly adjusted for each test. The gap may be fixed and an increasing voltage applied until breakdown occurs, or a constant voltage applied and the gap gradually shortened until rupture takes place.

Air Compressor Control Panels

The practice of protecting air compressor motors against overload by means of fuses still prevails among some railroads and manufacturing companies, but the General Electric Company is recommending protection by inverse time limit overload relays. The compressor control outfit comprises a panel adapted to floor or wall mounting for controlling a 50-cu. ft. air compressor driven by a three-phase, 60-cycle, 220-volt form K (squirrel-cage rotor) induction motor. One-phase wire is connected to the line through one pole of the triple pole lever switch, and the other two-phase wires through a double-pole contactor to the other two poles of the switch. The coil of the contactor is energized from one phase through contacts on the relays and the governor in series, so that the coil is energized when the relays are in their normal position and the contacts on the governor closed.

The governor is essentially a single-pole, single-throw, pneumatically-operated switch piped to the air receiver. It can be fitted with any one of three springs for a range of 40 to 60, 65 to 100 or 100 to 140 lb., and may be adjusted to cut in and out on 10 lb. variation in pressure with any of the springs. The equipment may be varied slightly for the control of two-phase, single-phase and direct-current motors.

Combined Vacuum Cleaner and Carpet Sweeper

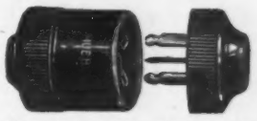
The vacuum cleaner shown in the accompanying illustration contains a revolving brush and a fiber gear drive which, it is claimed, makes the machine both noiseless and efficient. The machine really acts as a combined vacuum cleaner and carpet sweeper. The switch

VACUUM CLEANER THAT HAS A FIBER GEAR DRIVE

for controlling the cleaner is located directly under the curve in the handle, where it is protected from damage should the handle be allowed to fall. The curved part of the handle is made of highly polished fiber tube closed at the end. This cleaner is the product of the Ramey Company of Columbus, Ohio.

Three-Wire Composition Cord Connector

Harvey Hubbell, Inc., of Bridgeport, Conn., has added to its three-wire line of apparatus a 10-amp. cord connector shown in the accompanying illustration. This connector is used for permanently linking up installed wall or flush receptacles with portable machines, appliances and laboratory apparatus wired for three-wire service. The composition cap of this connector is interchangeable with all of the three-wire attachment plug bases, wall receptacles



10-AMP. CORD CONNECTOR

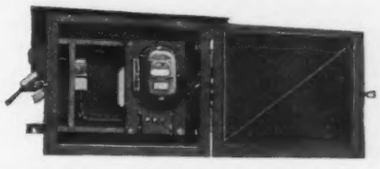
and flush receptacles made by this company. A small composition cord connector of durable construction has also been brought out to be used in connection with the Hubbell line of interchangeable attachment plugs, wall and flush receptacles. The cap of this device is interchangeable with both polarized and non-polarized Hubbell wall and flush receptacles, as well as the line of small attachment plugs.

Outdoor Switch Houses

Standard switch houses built by the large electrical manufacturing concerns are in general of two forms—ground-mounting and pole-mounting. They are constructed of steel throughout and are provided with a large door that gives easy access to the interior and that can be locked, thus protecting the apparatus from tampering by unauthorized persons. These houses are usually designed to contain an oil circuit breaker, a watt-hour meter with current transformers, and voltage transformers, besides calibrating and testing terminals and the usual wiring.

The chief advantages ascribed to the type of switch house shown herewith by the Westinghouse Electric & Manufacturing Company, its manufacturers, are low cost and ease with which it can be conveyed to localities where it is needed. With this equipment small communities and plants can be served by transmission lines that could not be reached economically from ordinary substations due to the high cost of construction. The houses are weatherproof.

The standard types of switch houses made by this company are built in capacities up to 600 amp. at 7500 volts, both single-phase and polyphase. The usual dimensions of such houses are 3 x 3 x 10 ft. high, although some special houses are being built in much



INTERIOR VIEW OF SWITCH-HOUSE

larger sizes. A contract has recently been taken by the Westinghouse company for a house 10 x 10 x 10 ft. high to contain the switching equipment for a 4000-kva., 13,200-volt, three-phase, 60-cycle installation.

New Incorporations

THE ALT-LE LIGHT & FIXTURE COMPANY of New York, N. Y., has been incorporated with a capital stock of $15,000 by H. and L. Altbach and L. Levitan, 868 Fable Street, the Bronx. The company proposes to manufacture gas fixtures, chandeliers, electroliers, etc.

THE UNIVERSAL GAS COMPANY of New York, N. Y., has been incorporated by M. B. Bernstein, N. Messinger and M. Ash, 61 Broadway, New York, N. Y. The company is capitalized at $25,000, and proposes to manufacture and deal in electrical devices, development of lamps, electroliers and chandeliers.

THE GENERAL OMNIBUS COMPANY OF AMERICA, of New York, N. Y., has been chartered with a capital stock of $10,000 to manufacture and deal in street cars, omnibuses, electric devices, car equipment, etc. The incorporators are: B. Grossman, H. J. Litt and S. Brand, 602 West 157th Street, New York, N. Y.

THE REDFIELD-KING COMPANY of Ogden, Utah, has been incorporated with a capital stock of $10,000 to conduct a general electrical service and sign business. The officers are: F. W. Redfield, president; Cleveland Redfield, vice-president; Carl Redfield, treasurer, and William G. King, secretary.

THE ORRVILLE (OHIO) ELECTRICAL & STORAGE BATTERY COMPANY has been organized by C. A. Waite and F. E. Welty. The company will deal in electrical supplies, and charge, repair and rebuild all makes of storage batteries.

THE PERFECT ELECTRIC BATTERY COMPANY of Brooklyn, N. Y., has been chartered by S. Fischer, J. Levy and H. Ratener, 490 Warwick Street, Brooklyn. The company is capitalized at $10,000 and proposes to manufacture and deal in electric batteries.

THE KLUNDER ELECTRIC COMPANY of Chicago, Ill., has been incorporated by John T. Janette, George H. Stellman and Eugene A. Monas. The company is capitalized at $10,000.

THE A. J. DOTTERWEICH COMPANY of Buffalo, N. Y., has been incorporated by A. J., G. J. and A. Dotterweich, 5 Hughes Avenue, Buffalo, N. Y. The company is capitalized at $15,000, and proposes to do a general electrical contracting business.

THE MUTE-A-PHONE COMPANY of Dover, Del., has been chartered with a capital stock of $100,000 to manufacture mute-a-phones for use on telephones. The incorporators are: Ferris Giles, K. M. Dougherty and E. Lynch of Wilmington, Del.

THE RO-CO BATTERY COMPANY of Brooklyn, N. Y., has been incorporated by William G. H. Kilpatrick, 154 Nassau Street; David Morris, 26 Oliver Street, New York City ,and others. The company is capitalized at $1,500, and proposes to manufacture all kinds of batteries and auto supplies.

THE KING ELECTRIC COMPANY of Canton, Ohio, has been incorporated with a capital stock of $30,000 to take over a Pittsburgh electrical manufacturing plant, which will be transferred to Canton in the spring. The company will engage in the manufacture of extension telephones and electrical novelties. Wendell Herbruck is attorney for the company.

CHARLES DUCHMAN, INC., of Buffalo, N. Y., has filed articles of incorporation with a capital stock of $10,000 for the purpose of dealing in lighting fixtures, etc. The incorporators are: C. C. A. and C. Duchman, 37 Filmore Aenue, Buffalo. N. Y.

THE BRENT ELECTRIC COMPANY of Tulsa, Okla., has been incorporated by W. A. Brent, T. C. Lichty and D. L. Thomas, all of Tulsa.

CHARLES H. PAGE & CO. of New York, N. Y., have been incorporated with a capital stock of $15,000 by P. C. Baer, C. H. Page and I. H. Levy, 135 West 179th Street, New York. The company proposes to deal in autos, motor cars, electric and mechanical supplies.

THE NO-GLARE STAR-LIGHT COMPANY of Jersey City, N. J., has been incorporated with a capital stock of $50,000 by Clem B. Sears, William H. Dickinson and Charles H. Dickinson, of Jersey City, N. J. The company will take over the establishment operating under the same name at Johnston Avenue and Grand Street, Jersey City.

THE ROWAN ELECTRIC MANUFACTURING COMPANY of Baltimore, Md., has been chartered with a capital stock of $4,000 to manufacture and deal in automatic starters, electric switchboards, remote-control switches and all kinds of machinery. The incorporators are: Benjamin H. Cram, D. Meredith Reese, John S. Rowan, Evan Rinehart and A. Bradford McElderry. Mr. Rowan will be resident agent of the company, with offices in the Garrett Building.

THE MILLHEIM (PA.) ELECTRIC COMPANY has been chartered with a capital stock of $5,000. A. J. Musser of Clearfield is one of the incorporators.

THE EASTERN WISCONSIN ELECTRIC COMPANY of Fond du Lac, Wis., has been incorporated with a capital stock of $10,000,000. The company has taken over the properties of the Eastern Wisconsin Railway & Light Company at Fond du Lac; the Wisconsin Electric Company at Oshkosh, and the Sheboygan (Wis.) Electric Railway Company. The officers of the company are: Joseph H. Brewer of Grand Rapids, Mich., president; Raymond H. Smith of Sheboygan, vice-president and general manager; Blaine Gavett of Grand Rapids, Mich., secretary, and Willis J. Ripley of Grand Rapids, Mich., treasurer.

THE FRENCH CREEK ELECTRIC COMPANY of St. Peter's, Pa., has been granted a charter with a capital stock of $10,000 to supply electricity for lamps, heaters and motors in Warwick Township. The incorporators are D. J. Knaue, treasurer; Guy W. Knau and W. Frank Noble.

THE LIBERTY & CAMDEN POWER COMPANY of Camden, Ohio, has been incorporated with a capital stock of $15,000 by William H. Glenn and others.

Trade Publications

HIGH-TENSION EQUIPMENT. — Outdoor substations, lightning arresters, pole top switches, choke coils, etc., are described and illustrated in bulletin No. 30, just issued by the Delta-Star Electric Company, Chicago. A unique feature is the showing of actual outdoor high-tension installations from 13,200 volts to 88,000 volts. There are 178 illustrations ,of which ninety-nine show commercial substations, etc., the remainder being devoted to equipment. Operating and construction engineers will find this publication of especial value.

HEATING DEVICES.—The American Electrical Heater Company, of Detroit, Mich., has issued price list No. 33 giving revised prices on its electrical heating devices.

STORAGE BATTERIES.—Bulletin No. 163, descriptive of the installation of the "Chloride Accumulator" for the Ford Motor Company of Detroit, Mich., has been prepared by the Electric Storage Battery Company of Philadelphia.

PLUGS.—Harvey Hubbell, Inc., of Bridgeport, Conn., is distributing a leaflet descriptive of its Hubbell slots in use on Hubbell plugs and receptacles.

DRYING MACHINES.—The Gordon Engineering Corporation, 96 Broadway, New York City, has recently prepared an illustrated bulletin descriptive of the Gordon standard compartment dryer.

MARINE ENGINES.—The Buffalo Gasolene Motor Company of Buffalo, N. Y., has prepared a catalog descriptive of its four-cycle marine engines.

RAILWAY MATERIAL.—The General Electric Company of Schenectady, N. Y., is distributing bulletin No. 44,001-K, which is a price list on renewal parts and supplies for car equipments, mine locomotives and railway and mine line material.

MINERS' LAMPS.—Bulletin No. 43,702 is being distributed by the General Electric Company of Schenectady, N. Y. This bulletin is descriptive of its miners' electric lamp.

METERS.—Portable test meters, types IB-5 and IB-6, for alternating-current circuits are illustrated and described in bulletin No. 46,291A recently issued by the General Electric Company of Schenectady, N. Y. This company has also issued bulletin No. 46,112 descriptive of its deflection potentiometer, and bulletin No. 46,208 descriptive of its single-phase prepayment watt-hour meter, type IP-5.

EXPANSION BOLTS.—The U. S. Expansion Bolt Company of New York City has just brought out a new 1917 catalog, which covers its line which represents a number of new styles brought out with a view toward rendering more efficient service to certain specialized branches of the building trade.

Trade Notes

SIEMENS BROTHERS DYNAMO WORKS, LTD., and SIEMENS BROTHERS & COMPANY, LTD., have removed their offices from Caxton House, Westminster, to Palace Place Mansions, Kensington Court, London, W.

COL. H. B. RAMEY, who for the past two and one-half years has been district manager of the storage battery division of the American Ever Ready Works' Chicago branch, has been appointed sales manager of the entire storage battery division. He took up his headquarters at the company's main office in Long Island City on March 1, and will direct the Every Ready storage battery sales organization throughout the United States. Colonel Ramey has been connected with the electrical industry for many years; first with the interests of the late E. W. Gillmer at Warren, Ohio, whose companies afterward were taken over by the National Electric Lamp Company. After a number of years' service with the latter organization he resigned to become sales manager of Robbins & Myers at Springfield, Ohio, and was later made assistant general manager.

THE GLOBE STOVE & RANGE COMPANY has issued its new price list on Globe electric ranges and heating devices. The highest priced range lists at $220 and the lowest price on any range is $65.

THE MARQUETTE ELECTRIC ENGINEERING COMPANY, INC., announces the opening on March 1 of a new switchboard department under the management of Paul Augustinus, vice-president of the company. This concern is now prepared to design and manufacture any form of power switchboard, panel-board and switch apparatus. Its office and factory is located at 212-216 West Austin Avenue, Chicago.

AMERICAN ELECTRIC TOOL COMPANY, Petersburg, Va., will manufacture and push the sale of the Paulero electric hammer. At a recent meeting a new board of directors was elected. The officers of the company are as follows: President, I. C. Shore; vice-president, B. Mason Hill; secretary and treasurer, David A. Lyon Jr.; general manager, Louis Paulero. The officers together with the following gentlemen compose the board of directors: W. G. Andrews, William L. McGill, Sol Cooper, J. H. Faber.

BARBER - JAMES - DWINNELL ELECTRIC & MANUFACTURING COMPANY announces that at the end of March it will move its factory to Topeka, Kan., where the company will have a modern factory building that will enable it to work more efficiently. About half of the company's business is in stationary storage batteries, which the company states are finding a large sale west of the Mississippi and in Canada. From present indications 1917 will be a better year for the company than 1916, which was a very prosperous one.

EMPIRE ELECTRIC SUPPLY COMPANY is the new corporate name of the Empire Fixture Works, Muskogee, Okla. In its announcement the company stated that there has been no change of management and that there will be no change in policy. The former name created the impression that the company manufactured fixtures only. It is announced that the electrical supply, fixture and gas supply departments are all being increased to better serve the trade.

INDUSTRIAL EXPOSITION AND EXPORT CONFERENCE. Change in the date of the Industrial Exposition and Export Conference at Springfield, Mass., to June 23 to 30 has been made to meet the wishes of a number of manufacturers who required more time than the earlier date (May 26 to June 2) permitted to make ready for such representation as they desired to have. Since the announcement of this commercial and industrial congress the Eastern States Exposition, which will conduct the affair, has developed its plans rapidly. A striking little booklet giving in brief space a concrete idea of what the exposition and conference will be is going to manufacturers, exporters and importers. A large general committee representative of the wide variety of American business interests is giving its services to the management in an advisory capacity, and is planning a series of small meetings in manufacturing centers to acquaint the trades generally with the opportunity to reach a great home market as well as to co-operate for a united front in the foreign field. F. H. Page, president of the National Equipment Company, has been made chairman of this general committee, to have charge of the exposition. John C. Simpson is the general manager.

New England

CASTINE, ME.—At a special town meeting held recently it was voted to install an electric-lighting system in Castine.

ST. ALBANS, VT.—The Public Service Electric Light Company is erecting an electric transmission line to Milton, a distance of 6 miles, and also a line to Cambridge and Jeffersonville, 9 miles long. The company has also purchased two General Electric 750-kva. generators, to be installed at the hydroelectric plant at Fairfax Falls within six months. The generators will be directly connected to Leffell waterwheels. A. W. Peterson is superintendent.

BOSTON, MASS.—A petition signed by merchants and property owners on Tremont Street, between Boylston and Pleasant Streets, asking for an ornamental lighting system and new pavement has been presented to Mayor Curley.

PLYMOUTH, MASS.—The State Gas and Electric Light Commissioners have authorized the Plymouth Electric Light Company to issue $130,000 in capital stock, the proceeds to be used for improvements.

Middle Atlantic

DUNKIRK, N. Y.—Plans have been completed by the Atlas Crucible Steel Company for the erection of an electrical building, 69 ft. by 100 ft.; also an addition to its gas producer building. J. H. Hegeman is manager.

MONROE, N. Y.—The Orange & Rockland Electric Company is erecting a high-tension transmission line to Highland Falls to supply energy to the Buttermilk Falls Electric Company. R. W. Smith is president.

NEW YORK, N. Y.—Plans, it is reported, have been prepared by the Interborough Rapid Transit Company for the erection of a transformer station, one story, 49 ft. by 99 ft., at 77-79 Murray Street; also for construction of a transformer station and telephone exchange, 49 ft. by 108 ft., two stories high, at 122-126 Park Row; and also a transformer station, one story, 49 ft. by 108 ft., at 150-154 East Fifty-seventh Street. The cost of the stations is estimated at about $45,000 each. George H. Pegram, 165 Broadway, is chief engineer.

NEW YORK, N. Y.—Bids will be received by the Department of Public Charities, Tenth Floor, Municipal Building, New York City, until March 22, for furnishing material and labor required for contract No. 4 in the construction of 21 pavilion buildings, a group building and a dining hall at Sea View Hospital, borough of Richmond, city of New York. Blank forms and further information may be obtained at the office of Renwick, Aspinwall & Tucker, architects, 8 West Fortieth Street, New York City, where plans and specifications may be seen.

SYRACUSE, N. Y.—Bids will be received by the State Fair Committee, 428 South Salina Street, Syracuse, until April 2 for construction of horse exhibit building, including electrical work and plumbing, at the New York State Fair, Syracuse. Drawings and specifications, etc., may be obtained at the office of Lewis F. Pilcher, state architect, State Capitol, Albany, N. Y.

UTICA, N. Y.—Plans are being prepared by the Bosser Corporation, 1019 Hickorty Street, for the construction of a power plant, to cost about $50,000. J. S. Schneider is architect.

CONESTOGA, PA.—Plans have been prepared by the Conestoga Traction Company for improvements to its plant and system, which will include the installation of new rotary converter equipment in the Orange Street station and a 15,000-kw. transformer bank installation at the Engleside power plant, to cost about $125,000.

PHILADELPHIA, PA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until April 2 for construction of a steel frame building for machine and electrical shop at the navy yard, Philadelphia, Pa.

PHILADELPHIA, PA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until April 2 for furnishing and installing one 150-ton, two 15-ton, one 20-ton, and one 5-ton electric traveling bridge cranes at the navy yard, Philadelphia, Pa. Drawing and specifications (No. 2330) may be obtained on application to the above bureau or the commandant of the navy yard named.

POTTSVILLE, PA.—The Philadelphia & Reading Coal & Coke Company is planning to install a power plant to supply energy to operate its Knickerbocker Mine. It is also proposed to erect a distributing system to neighboring sections to supply electricity for domestic purposes.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

SOUTH BETHLEHEM, PA. — Bids will be received at the Chamber of Commerce Rooms, South Bethlehem, until March 26 for furnishing and installing an ornamental street-lighting system for the Third Street Lighting Association. For details see proposal columns.

PERTH AMBOY, N. J.—The Board of Aldermen plans to make the street-lighting system proposed for Smith Street a municipal enterprise, with service supplied from the city plant.

TRENTON, N. J. — Repair shops, equipped to handle electrical and automobile repair work, will be installed in the electrical bureau and garage now under construction by the City Commission on West Hanover Street, at a cost of about $78,000.

BALTIMORE, MD. — The United Railways & Electric Company contemplates the construction of a new substation for the Sparrows Point line. The new substation will be similar to the one recently erected on Belvidere Avenue.

WASHINGTON, D. C. — Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until April 9 for furnishing and installing two electrically operated locomotive jib cranes of 50 gross tons capacity at the navy yards, Norfolk, Va., and Philadelphia, Pa. Plans and specifications (No. 2332) can be obtained on application to the above bureau or to the commandants of the navy yards named.

WASHINGTON, D. C. Bids will be received by the General Supply Committee, Treasury Department, Washington, D. C., until April 3 for furnishing as may be ordered during the fiscal year ending June 30, 1918, as follows: Class 15, incandescent electric lamps; Class, 16, incandescent gas lamp supplies for use in Washington by the executive departments and other establishments of the government. Proposals with instructions may be obtained upon application to the General Supply Committee, Auditors' Building, Washington, D. C.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Washington, D. C.—Schedule 808, 20 portable anemometers, or airmeters. Puget Sound, Wash.—Schedule 818, four water tube boilers; Schedule 839, 500 steel wire casting brushes; Schedule 839, 300 lb. packing for condenser tubes, 700 scoop type coaling shovels; Schedule 819, miscellaneous air, main, feed, fuel oil, etc., pumps; Schedule 817, one air compressor. Norfolk, Va.—Schedule 823, 1800 ft. vitrified conduit, 5150 ft. 3-conductor cable, miscellaneous electrical, wire, switches, fuses, blocks, etc., supplies. Portsmouth, N. H.—Schedule 807, one locomotive crane. Brooklyn, N. Y.—Schedule 834, miscellaneous flexible copper steam hose, 11,000 ft. plain single-conductor cable; Schedule 825, 50,000 ft. 4-conductor cable; Schedule 829, 8000 lb. weatherproof wire; Schedule 815, miscellaneous twin conductor. Philadelphia, Pa., and Norfolk, Va.—Schedule 823, 4940 ft. single-conductor cable. Brooklyn, N. Y., Mare Island, Cal.—Schedule 815, 12,600 ft. 4-conductor cable. Philadelphia, Pa.—Schedule 829, 8000 ft. flexible cord for portables; Schedule 833, miscellaneous iron or steel black wire. Charleston, S. C.—Schedule 813, one each, electric, welding and cutting outfit. Mare Island, Cal., Puget Sound, Wash.—Schedule 838, miscellaneous soft galvanized iron or steel wire. Applications for proposal blanks should designate the schedule desired by number.

North Central

BANGOR, MICH.—The Village Council has decided to submit to the voters the proposal to issue bonds for improvements to the municipal electric-light and water plant. P. M. Gross is superintendent.

GRAND RAPIDS, MICH.—Plans are being considered by the Board of Public Works for the installation of a new street-lighting system, to cost about $55,000. If the necessary money can be secured it is proposed to replace the arc lamp now in use with nitrogen-filled lamps of 600 cp. The proposed change will require the purchase of a new generator, which will cost about $30,000.

CINCINNATI, OHIO.—Bids will be received at the office of the director of public service, City Hall, Cincinnati, until March 21 for the installation of a lighting system for the Hopple Street Viaduct. Plans and specifications can be obtained at the office of the city electrician, City Hall. Charles F. Hornberger is director of public service.

CINCINNATI, OHIO.—Bids will be received by the New Longview Hospital Buildings Commission of Hamilton County, at the office of the Board of County Commissioners, Court House, Cincinnati, until March 21 for furnishing material and constructing of new women's receiving cottage, including heating, ventilating, electric work, elevator, etc., at the Longview Hospital and also power house and power plant equipment. Plans and specifications may be obtained at the office of Elzner & Anderson, architects, Ingalls Building, Cincinnati.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, until March 27 for furnishing and installing stokers for the division of light and heat. Bids will also be received at the same time and place for furnishing waterproof copper wire for the division of light and heat. Specifications may be obtained at the office of division of light and heat, Room 204 City Hall.

COLUMBUS, OHIO.—The Ohio Utilities Commission has granted the Columbus Railway, Power & Light Company permission to issue $508,200 in capital stock and $1,846,000 in bonds, the proceeds to be used to pay for improvements already made and new construction work, which includes the erection of a large power plant on Big Walnut Creek, to cost about $700,000; the purchase of ten new cars, $60,000; other car house and associated equipment, $90,000; for the erection of additional circuits, including meters and equipment, $300,000.

DAYTON, OHIO.—The County Commissioners of Montgomery and Preble Counties have decided to issue $90,000 in bonds, the proceeds to be used for purchase of boilers, pumping equipment and other equipment for the new tuberculosis hospital to be built jointly by the two counties.

EAST PALESTINE, OHIO.—The general contract for construction of power plant and pumping station for city of East Palestine was awarded to J. E. Madden of East Palestine.

MOGADORE, OHIO.—Plans have been prepared for the construction of two factory buildings, one 162 ft. by 60 ft., two stories high, the other 34 ft. by 80 ft., and power house 60 ft. by 64 ft., one story, for the India Rubber Company, to cost about $100,000. J. M. Alderfer, 60 Cherry Street, Akron, president, it is understood, is now asking for separate bids for the work.

MURRAY KY.—Bids will be received by the Mayor and City Council of Murray until March 29 for furnishing material, equipment, etc., in connection with improvements to water-works system, including furnishing oil engines, pumps, well-working equipment and pumphouse; also construction of an electric-lighting system, which includes furnishing alternators, switchboard, street-lighting equipment, wire, poles and line material. Specifications, plans, etc., may be obtained upon application to Xavier A. Kramer, Magnolia, Miss., consulting engineer.

PADUCAH, KY.—The City Council has engaged F. G. Proutt and A. L. Dabnay of Memphis, Tenn., engineers, to prepare plans for extensions to the municipal electric-light plant.

TOMPKINSVILLE, KY. — The electric plant of the Tompkinsville Electric Light & Ice Company was recently destroyed by fire, causing a loss of about $8,000. Arrangements are being made for temporary service and also for rebuilding the plant. By mistake this item appeared under Tompkinsville, N. Y., in the issue of March 10.

GEORGETOWN, IND.—A franchise has been granted to Robert Hurst of Pekin to construct and operate an electric-light and power plant in Georgetown for a period of 25 years. The proposed plant will be equipped with oil engines.

LA SALLE, ILL.—At an election to be held March 20 the proposal to issue $23,000 in bonds for improvements to water and light systems will be submitted to the voters.

MONMOUTH, ILL.—Bids will be received by the Sixth Regiment Armory Commission, Illinois Infantry, National Guard, in the office of James B. Dibelka, 130 North Fifth Avenue, Chicago, until March 26 for erection of Sixth Regiment Armory Building at Monmouth, Ill. Separate bids will be received for general work, plumbing and sewerage, heating and electrical wiring. Plans

and specifications may be obtained at the office of the state architect upon deposit of $10.

SAVANNA, ILL.—We are informed that the People's Gas & Electric Company does not contemplate the erection of an electric transmission line to Mount Carroll, as reported in the issue of Feb. 3, as this line is already completed.

CLINTONVILLE, WIS.—Bids, it is reported, will be received by the Water and Light Commission, Clintonville, until March 19 for furnishing two 250-hp. fire or water tube boilers and one 1000-hp. cast-iron or open feed water heater.

MILWAUKEE, WIS.—Plans are being considered by the Hummel & Downing Company for the construction of a power house. C. C. Uehling, First National Bank Building, Milwaukee, is architect.

MILWAUKEE, WIS.—Plans are being prepared by the Evinrude Motor Company, 279 Walker Street, Milwaukee, for the construction of a complete new gas and oil engine and motor manufacturing plant, to cost about $250,000. The company, it is reported, is in the market for the purchase of tools, machinery and power equipment.

MILWAUKEE, WIS.—Arrangements have been completed by the Northwestern Bridge & Iron Company, 127 South Water Street, Milwaukee, for construction and equipment of a new structural fabricating plant, to be located at Twenty-seventh and Hopkins Streets. The building will be 100 ft. by 180 ft., two stories high, and will be equipped throughout with electrically operated machinery.

ROCHESTER, MINN.—Bids will be received by the Common Council of the city of Rochester, Minn., until April 2 for construction of a hydroelectric power plant and dam on the south fork of the Zumbro River, separate bids to be submitted as follows: For details see proposal columns. Hugh L. Cooper & Company, 101 Park Avenue, New York, N. Y., are consulting engineers.

ST. PAUL, MINN.—Plans have been completed by the Twin City Rapid Transit Company of Minneapolis for the erection of a new substation, 200 ft. by 240 ft., in St. Paul, to cost about $25,000.

ST. PAUL, MINN.—Franchises have been granted to the Northern States Power Company, 206 South La Salle Street, Chicago, Ill., to supply electricity for lamps and motors in Heron Lake, Bingham Lake and Okabena.

ALBIA, IOWA.—The Albia Light & Railway Company is rebuilding its entire plant. Ralph W. Boyer is manager.

REPUBLIC, MO.—A continuous electric service will be established by the Republic Lighting Company in April. H. L. Pennoyer is secretary.

VERSAILLES, MO.—Bonds to the amount of $6,000 have been voted for improvements to the municipal electric-light plant.

HARVARD, NEB.—The installation of a 75-hp. oil engine directly connected to a 220-volt, direct-current generator, is under consideration by the Harvard Electric Company. A. W. Person is manager.

LOVELOCK, NEB.—Preliminary work has begun on the construction of a hydroelectric power plant for the Nevada Valleys Power Company of Lovelock on the Truckee River, a short distance below Vista, where about 2500 hp. will be developed.

AGRA, KAN.—An election will soon be called to submit to the voters the proposal to establish a municipal electric light plant to the voter.

BONNER SPRINGS, KAN.—The Bonner Springs Electric & Manufacturing Company is negotiating with the city of De Soto relative to furnishing energy in bulk to that city. J. E. Straus is manager of the electric company.

BRONSON, KAN.—At an election to be held April 2 the proposal to establish a municipal electric light plant in Bronson will be submitted to the voters.

WHITE WATER, KAN.—The Kansas Gas & Electric Company of Wichita is contemplating extending its transmission lines to White Water and making improvements to the local plant.

Southern States

CHARLESTON, S. C.—Bids will be received by Todd, Simons & Todd, architects, 63 Broad Street, Charleston, until March 29 for the construction of a four-story hospital building complete; also for building complete except heating, plumbing, electric wiring and elevators, bids for which will be received separately. Plans and specifications may be obtained upon application to the architects upon deposit of $25, of which $15 will be refunded upon return of plans.

EMERSON, GA.—The Georgia Railway & Power Company of Atlanta is contemplating the installation of a power station and the erection of electric transmission lines in the Emerson district.

CENTERVILLE, TENN.—The installation of an electric-light plant and waterworks system is under consideration.

ROANOKE, ALA.—At an election held recently the proposal to sell the municipal electric lighting plant to the Alabama Power Company was carried.

AGRICULTURAL COLLEGE, MISS.—Bids will be received by W. H. Smith, president of the Board of Trustees, Agricultural College, until March 24 for construction of addition to dormitory, separate bids to be submitted on plumbing, heating and electrical wiring. Plans and specifications may be obtained upon application to Xavier A. Kramer, consulting engineer and architect, Magnolia, Miss., upon deposit of $25.

GILLHAM, ARK.—The B. & A. Mining Company of Okmulgee and Gillham is contemplating the construction of a hydroelectric plant.

STEPHENS, ARK.—The installation of an electric-light plant in Stephens is under consideration. J. R. Whaley is reported interested.

BILLINGS, OKLA. — The City Council has engaged Mackintosh-Walton Engineering Company, 1023 National Bank Building, Oklahoma City, as engineer in connection with the installation of an electric-light plant, water-works and sewer system, to cost about $50,000. The proposal to issue bonds for the above work will be submitted to the voters.

GRANDFIELD, OKLA.—The local electric-light plant and ice factory, owned by Maple & Green, which was recently destroyed by fire, it is reported, will be rebuilt.

MOUNTAIN PARK, OKLA.—The city of Mountain Park is contemplateing the installation of an electric-lighting system.

OKLAHOMA CITY, OKLA.—The Oklahoma Gas & Electric Company contemplates extending its transmission lines to El Reno and Enid.

WEST TULSA, OLKA.—The City Council will soon call an election to submit to the voters the proposal to issue bonds for improvements to electric-lighting system, construction of water works and fire protection.

COLUMBUS, TEX.—A franchise has been granted to E. C. Guilmartin, manager of the Texas Motor Company, to construct and operate an electric-light plant in Columbus.

DENISON, TEX.—It is announced that as soon as the United States Bureau of Indian Affairs approves the proposal of the Texas Power & Light Company and the Texas Electric Company to build an electric power plant on the north bank of the Red River in Oklahoma, 5 miles north of Denison, construction work will be started. Authority has already been granted by the State of Oklahoma.

PANHANDLE TEX.—The City Council is considering calling a special election for the purpose of submitting the proposal to issue bonds for the installation of a municipal electric plant to the voters.

Pacific States

SHELTON, WASH.—Application has been made to the Commissioners of Mason County by Frank MacKean, president and manager of the Mason County Power Company, for a franchise to erect transmission lines for the distribution of electricity from a power plant now under construction on the North Fork of the Snohomish River near Hoodsport on Hoods Canal.

PORTLAND, ORE.—The City Council has authorized the city attorney to prepare a charter amendment authorizing an issue of $1,776,000 in bonds to cover the cost of establishment of a municipal electric plant on the Bull Run reservation to supply electricity for lighting the streets and public buildings.

FRESNO, CAL.—In connection with the proposed bond issue of $4,500,000 of the San Joaquin Light & Power Corporation, the immediate issue of $1,000,000 will be used as follows: Increasing the output of the Kern River power station by about 4000 kw.; construction work and installation at power house No. 2 on North Fork River, Madera County; extending transmission and distributing lines, installation of new transformer stations, new meters and other equipment. A. G. Wishon of Fresno is general manager.

LOS ANGELES, CAL.—The construction of four hydroelectric plants on Whitewater River and Snow Creek is reported under consideration. Marcus Pluth, 111 West Nineteenth Street, Los Angeles, is reported interested.

MONROVIA, CAL.—The Southern California Edison Company has submitted a proposal to the City Council offering to install a new electrolier system on White Oak Avenue, consisting of 101 ornamental lamp standards, equipped with 16-in. globes, for $7,500.

OROVILLE, CAL.—Plans for the construction of a large hydroelectric power plant at a point of the Feather River, 3 miles from Oroville, have been announced by the Great Western Power Company, 14 Sansome Street, San Francisco. The proposed plant will have an output of 75,000 kw. and will cost about $6,000,000. The plans call for the construction of a cement canal 15 miles long.

SAN FRANCISCO, CAL.—Appropriations amounting to $575,000 have been asked for improvements, etc., for the Yosemite Park, of which $150,000 will be used for construction of power plant.

SAN LUIS OBISPO, CAL.—Plans are being considered for the installation of an ornamental street-lighting system in the business section. New suspension lamps will be erected in the residential section.

WATTS, CAL.—Plans are being considered by the City Trustees for the installation of an ornamental street-lighting system, consisting of about 50 standards, on Main Street.

CASA GRANDE, ARIZ.—Contract for the installation of the proposed municipal electric-light plant has been awarded to the Schweiter Machine Company of Tucson, at about $25,000.

LIVINGSTON, MONT.—The City Council is considering the installation of a new street-lighting system. The Montana Power Company furnishes electrical service in Livingston.

OSWEGO, MONT.—The County Commissioners have adopted a resolution authorizing the town of Oswego to issue bonds for the installation of an electric-light and power plant. The cost of the plant is estimated at $8,500.

COWLEY, WYO.—The Cowley Electric Light Company is contemplating installing, in the near future, a new power plant to meet the increasing demands for electrical service. Natural gas will be used for power. C. S. Vaterlaus is owner and manager.

Canada

EDMONTON, ALTA.—The City Council is considering improvements and alterations to the municipal telephone system, involving an expenditure of about $38,899. W. T. Lowney is superintendent of telephone department.

LETHBRIDGE, ALTA.—The purchase of a new auxiliary motor for the turbo-generator, to cost $7,000, at the municipal electric-light plant has been authorized by the City Council.

NELSON, B. C.—The City Council is considering the installation of a third generating unit in the municipal electric plant.

WIARTON, ONT.—The Town Council is negotiating with the Ontario Hydro-Electric Power Commission for the installation of an electric distributing system.

COATICOOK, QUE.—The construction of a power plant, including power house and concrete dam, is under consideration by Penman's, Ltd. A 180-hp. turbine to be directly connected to generator will be installed. T. Pringle & Son, Coristine Building, are engineers.

DESCHAMBAULT, QUE.—The Portneuf Hydraulic Company contemplates the erection of 5 or 10 miles of electric transmission lines next spring. Henri Paré is manager.

SWIFT CURRENT, SASK.—Tenders, it is reported, will soon be asked for a 615-hp. oil engine for the city electrical department. J. N. Calder is electrical engineer.

Miscellaneous

PANAMA.—Bids will be received at the office of the Panama Canal, Washington, D. C., until March 31 for furnishing steel, galvanized pipe, boiler tubes, chain, steel rolling door, brass tubing, trolleys, geared blocks, electroplating apparatus, turbine oil, etc. Blanks and information relating to this circular (No. 1130) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York City; 614 Whitney-Central Building, New Orleans, La., and Fort Mason, San Francisco, Cal.

1,217,902. MINER'S BLASTING BOX; Joseph S. Beeneck, Nanticoke, Pa. App. filed Dec. 31, 1915. Safety.

1,217,924. CONNECTOR; Harry A. Douglas, Bronson, Mich. App. filed May 22, 1914. Employed for effecting circuit connection between the lighting bulbs or reflecting lamps and the source of current for such lamps.

1,217,928. GOVERNOR MAGNET; Thomas Farmer, Jr., New York, N. Y. App. filed Sept. 5, 1913. Device for opening and closing an electric circuit containing a governor magnet for an electric switch.

1,217,943. COIL SUPPORT; Ole M. Holst, Wilkinsburg, Pa. App. filed Dec. 28, 1912. For field coils.

1,217,964. ELECTRICAL CONTACT DEVICE; Joseph Frederick Lamb, New Britain, Conn. App. filed June 23, 1916. Socket contact device suitable for use with cord connections.

1,217,967. WATER HEATER; Antonio Longoria, Cleveland, Ohio. App. filed July 15, 1915. Self-contained unit.

1,217,982. ELECTRIC-CIRCUIT CONTROLLER; Will C. Neahr, Denver, Col. App. filed Oct. 21, 1915. Thermostatic means.

1,217,994. THERMOSTAT FOR ELECTRIC HEATING AND COOKING APPARATUS; Roderick J. M. Parke and Edward D. Brand, Toronto, Ontario, Canada. App. filed Dec. 19, 1913. Easily calibrated and set.

1,218,015. METHOD AND SYSTEM OF SELECTIVE CHARACTER DISPLAY; John P. Tarbox, Washington, D. C. App. filed Feb. 2, 1914. Flashing signs.

1,218,016. DISPLAY-REGISTERING SYSTEM; John P. Tarbox, Buffalo, N. Y. App. filed Sept. 15, 1915. Keyboard-operated type.

1,218,022. ELECTRIC MACHINE; Reinhold H. Wappler, New York, N. Y. App. filed Jan. 4, 1916. For developing electrical currents and impulses of high potential and high frequency, and particularly to such machines adapted for therapeutical purposes.

1,218,026. X-RAY TUBE; Fred A. Wiggin, Lawrence, Mass. App. filed Oct. 5, 1916. Improvements in targets.

1,218,035. TELEGRAPH SOUNDER; Roy M. Allen, East Orange, N. J. App. filed Sept. 25, 1915. Improved electromagnetic structure.

1,218,037. ELECTRIC SWITCH; Harry N. Alter, Chicago, Ill. App. filed Jan. 17, 1917. Snap switches.

1,218,042. TERMINAL FOR ELECTRIC FURNACES; Thaddeus F. Baily and Frank T. Cope, Alliance, Ohio. App. filed April 27, 1915. Prevent the electrode from oxidizing at the point where it enters the furnace.

1,218,048. AUTOMATIC SELECTING SWITCH; John G. Blessing, Chicago, Ill. App. filed March 29, 1912. Automatic telephone system.

1,218,058. ELECTRIC FURNACE; Frank T. Cope, Alliance, Ohio. App. filed April 27, 1915. Resistance trough is so located within the heating chamber that air spaces are provided around the trough allowing the air to circulate around the trough for the purpose of preventing excessive overheating of the same.

1,218,059. SELECTIVE OIL-BREAK SWITCH; Frank T. Cope, Alliance, Ohio. App. filed May 13, 1915. For use in raising or lowering the voltage through a transformer.

1,218,061. AUTOMATIC SAFETY DEVICE; David F. Crawford, Pittsburgh, Pa. App. filed Feb. 11, 1913. Railway service.

1,218,062. ELECTRIC SWITCH SUITABLE FOR USE IN TELEGRAPHY; Frederick George Creed, Croydon, England. App. filed Aug. 24, 1914. For use in transmitting systems.

1,218,076. COMMUTATOR; Alfred C. Gilbert, New Haven, Conn. App. filed June 23, 1916. Armatures of toy electric motors, and in connection with reversing switches for such motors.

1,218,099. SIGNALING DEVICE; Ray H. Manson, Elyria, Ohio. App. filed Aug. 14, 1911. Employed upon self propelled vehicles.

1,218,106. ELECTRICAL FUSE CONNECTION; James J. Mullen, St. Louis, Mo. App. filed March 16, 1915. High voltage.

1,218,123. ELECTRIC SWITCHING DEVICE; Melvin L. Severy, Arlington Heights, Mass. App. filed July 8, 1913. Circuit opening and closing devices.

1,218,151. ELECTRIC INDUCTION FURNACE; Parvin Wright, Vancouver, British Columbia, Canada. App. filed May 11, 1914. Continuous in its operation and constant in its current consumption.

Record of Electrical Patents

Notes on United States Patents issued on March 4, 1917

1,218,162. PORTABLE LIGHT; Edmund H. Becker, Washington, D. C. App. filed May 29, 1916. Self contained.

1,218,165. TELEGRAPH TYPEWRITER; Allen D. Cardwell, Brooklyn, N. Y. App. filed April 10, 1915. May be operated over an ordinary Morse telegraph line or any other desired circuit..

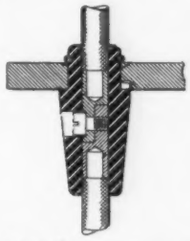
1,218,167. THERMOSTAT; Harold J. Carmody, Brooklyn, N. Y. App. filed Nov. 16, 1915. For service upon automobile radiators.

1,218,177. METALLURGICAL PROCESS; William E. Greenawalt, Denver, Col. App. filed Jan. 17, 1917. Cheap recovery of copper from its ores with a simultaneous recovery of the sulphur combined with the copper when precipitated as the sulphid.

1,218,181. INSULATOR KNOB; John W. Homer, Greencastle, Pa. App. filed Feb. 24, 1915. For holding together the two parts of a porcelain insulator or knob.

1,218,182. TELEPHONY; David S. Hulfish, Toronto, Ontario, Canada. App. filed Aug. 7, 1915. Application of methods and apparatus for telephone exchanges.

1,218,195. SYSTEM FOR TRANSMITTING COMMUNICATIONS; Charles V. Logwood, New York, N. Y. App. filed Jan. 22, 1916. High-frequency continuous oscillating electrical waves.



1,218,216. Connector

1,218,198. ALARM BOX; Charles A. Mahla, Jersey City, N. J. App. filed April 15, 1915. Receptacle for valuables.

1,218,205. ELECTRICAL RESISTANCE UNIT; Horace N. Packard, Milwaukee, Wis. App. filed July 29, 1913. Electrical resistance thermometers.

1,218,216. CONNECTOR; Rudolf Schmid, Jr., West Allis, Wis. App. filed May 17, 1912. Readily assembled and taken apart.

1,218,221. FUSE BLOCK; Charles H. Smith, Chicago, Ill. App. filed July 21, 1913. Improved means for constructing the mounting devices for holding removable fuse units.

1,218,230. FIRE-ALARM BOX; Anthony C. Vanadia, Flint, Mich. App. filed Aug. 11, 1916. Improvement.

1,218,236. POWER-DRIVEN TOOL; Frank J. Backschneider, Cincinnati, Ohio. App. filed Oct. 17, 1912. Portable electric tools.

1,218,237. METHOD AND APPARATUS FOR DETERMINING THE DIRECTION OF A HERTZIAN LIGHTHOUSE; Andre Blondel, Paris, France. App. filed Nov. 4, 1913. New method of signaling.

1,218,265. ELECTRIC WELDING; Otis Allen Kenyon, New York, N. Y. App. filed June 28, 1916. Improvements.

1,218,266. ELECTRIC WELDING; Otis Allen Kenyon, New York, N. Y. App. filed June 28, 1916. Adjust and control the heating effect of the arc by a combination of a voltage limitation and the power limitation.

1,218,267. ELECTRIC WELDING; Otis Allen Kenyon, New York, N. Y. App. filed June 28, 1916. Improvements.

1,218,268. ELECTRIC WELDING; Otis Allen Kenyon, New York, N. Y. App. filed June 28, 1916. Adjust the current in the arc by means of a combination of resistances.

1,218,269. ELECTRIC WELDING; Otis Allen Kenyon, New York, N. Y. App. filed June 28, 1916. Improvements.

1,218,274. QUADRUPLEX TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed June 3, 1912. Quadruplexing lines with great capacity, such, for instance, as submarine cables.

1,218,281. INDICATOR; Max O. Kuhn and Harold C. Shoolbread, Montreal, Quebec, Canada. App. filed Jan. 28, 1916. May be mounted upon street cars, railway cars or the like.

1,218,299. GAS VALVE; Maximilian J. Myszker, Buffalo, N. Y. App. filed Oct. 10, 1914. Sounding an alarm when the gas pressure is reduced.

1,218,324. SOUND-PRODUCING DEVICE; Melvin L. Severy, Arlington Heights, Mass. App. filed March 22, 1913. Sonorous vibrations are produced electromagnetically by the movement of phonograms of magnetic material past electromagnetic sound producing mechanism.

1,218,329. RETAINING ENVELOP OR COVER FOR STORAGE-BATTERY ELECTRODES; Edward W. Smith and Edward G. Steinmetz, Philadelphia, Pa. App. filed July 1, 1911. New and useful.

1,218,341. ELECTRIC OVEN; Clarence Truitt, Pomona, Cal. App. filed July 11, 1914. Loss by conduction being practically eliminated.

1,218,397. ELECTRIC CHAIN-WELDING MACHINE; Jacob Ross Grove, York, Pa. App. filed July 12, 1916. Welded by compression or by compression and swaging.

1,218,401. PUSH SWITCH; Henry G. Hillman, New York, N. Y. App. filed Sept. 11, 1916. Contacts have a straight edge and long sliding engagement to obviate the effects of arcing.

1,218,407. ELECTRICAL APPLIANCE FOR PANELBOARDS; Ralph E. Jones, Syracuse, N. Y. App. filed June 23, 1914. Push-button switch.

1,218,413. QUADRUPLEX TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed Dec. 30, 1916. May be applied to overhead as well as underground lines.

1,218,423. ROENTGEN-RAY TUBE; Julius Edgar Lilienfeld, Leipzig, Germany. App. filed July 25, 1916. Improvements.

1,218,465. TERMINAL FOR RESISTANCE MEMBERS AND METHOD OF PRODUCING SAME; Ludwig Reichold, Pittsfield, Mass. App. filed Dec. 5, 1914. Relates to electric heating devices.

1,218,475. ELECTRICAL-CONDUCTOR CONNECTOR; Hugh Douglas Rothwell and Gordon Kribs, Toronto, Ontario, Canada. App. filed March 25, 1916. Means for positively connecting the terminal ends of electrical conductors so as to make a perfect electrical contact between the parts.

1,218,480. INSULATOR; John Sayer, Flagstaff, Ariz. App. filed May 26, 1916. For strengthening or reinforcing various forms of fragile insulators.

1,218,485. SOCKET PIECE FOR ELECTRIC LAMPS; Jason C. Stearns, Worcester, Mass. App. filed June 19, 1916. For use in mounting a lamp in a reflector for a motor vehicle.

1,218,509. ARC LAMP; John T. Beechlyn, Lynn, Mass. App. filed May 8, 1912. Focusing type.

1,218,538. METERING DEVICE FOR ELECTRICAL DISTRIBUTING APPARATUS; Evan Evans, Berlin, Germany, App. filed Feb. 10, 1914. Electric meter operatively connected to the secondary winding of a transformer for registering the total electric energy supplied to the transformer at any and all times, whether the transformer is loaded or not.

1,218,552. SWITCHING DEVICE; Edward F. Hamill, Chicago, Ill. App. filed March 18, 1915. Silent call wall switches for hospitals.

1,218,553. FUSE CARRIER; William A. Harvey, Scranton, Pa. App. filed Oct. 3, 1912. Plug fuse.

1,218,555. TROLLEY WHEEL MOUNTING; Henry Holland, Cleveland, Ohio. App. filed Jan. 11, 1915. Improvements.

1,218,563. SIGNALING SYSTEM; Morton L. Johnson, Chicago, Ill. App. filed Dec. 4, 1915. For use in a department store.

1,218,570. MINER'S SAFETY ELECTRIC LAMP; Richard Koch, Pittsburgh, Pa. App. filed Aug. 17, 1916. Impossible for the workmen to tamper with the lamp.

1,218,571. WIRE TERMINAL; Burton L. Lawton, Meriden, Conn. App. filed Feb. 25, 1916. Tubular handle into the open end of which the end of a wire is inserted and mounted on the opposite end of said handle a terminal clip.

1,218,582. Electric Furnace; Carl A. Pfanstiehl, Waukegan, Ill. App. filed April 15, 1915. Improvements.

1,218,584. Electrode for Generating Pure Oxygen; John F. Sanders, Roseburg, Ore. App. filed Aug. 4, 1915. In such quantities as may be required on board a submarine boat while under the water.

Record of Electrical Patents

Issued on Feb. 27

Continued from March 10
Electrical World

1,216,946. Acoustic Multiplier; Edward E. Clement, Washington, D. C. App. filed March 16, 1912. Improving transmission through an ear trumpet, improving the reproduction of phonographic records, and improving the action of telephonic transmitters.

1,216,947. Method of Electric-Arc Welding, Heating and Metal-Working and Apparatus Therefor; Charles L. Coffin, Parks, Ga. App. filed April 5, 1916. Improvements.

1,216,960. System of Suspension for Tramway and Railway Cars; Celestin Delmez, Antwerp, Belgium. App. filed Aug. 7, 1916. Relates to a car suspension combined with ball bearing and motor suspension.

1,216,961. Electric Furnace; Hector de Nolly, St. Chamond, France. App. filed Jan. 31, 1914. Electric furnace suitable for all purposes in the electro-chemical industry.

1,216,982. Railway-Signal; Albert Ernest Gauthier, Bay City, Mich. App. filed Jan. 6, 1915. Arranged upon a train in such manner as to operate an alarm in the cab of the locomotive of the train should one of the cars of the train become detached.

1,217,000. Stationary Electric-Iron Heater; Abraham S. Iserson, N. Y. App. filed Sept. 9, 1916. Electric connection for a flat iron which will be independent of the iron when the iron is in actual use for laundrying purposes.

1,217,032. Insulator for Electric Wires; Cody Lyon, Emmett, Idaho. App. filed Aug. 11, 1915. So constructed that the wire when turned at right angles to the entrance kerf or when the insulator is turned at right angles with relation to the wire, the wire will be held securely in position upon the insulator without the necessity of binding wires.

1,217,036. Rain-Signal; Edwin J. McManus, Cazenovia, N. Y. App. filed Aug. 6, 1915. Indicating a coming rain storm.

1,217,069. Safety and Signal Apparatus for Fire-Alarm Boxes; Michael Rugel, Milwaukee, Wis. App. filed July 5, 1916. Automatic means for imprisoning the person sending in an alarm.

Recent Radio Patents

Notes and Comments on United States Patents on Radio Signaling and allied topics issued during February, 1917.

1,214,591. Antenna for Radio Telegraph Stations; G. Reuthe, Sayville, N. Y. App. filed April 29, 1916; issued Feb. 6, 1917. For transmitting, the sending apparatus is connected between a tall antenna structure and a low counterpoise, while for receiving, the instruments are connected between separate portions of the counterpoise, or between the counterpoise and earth. Thus the tall sending antenna acts as a screen to protect the counterpoise from charges, and the counterpoise itself is used, either in whole or in part, as the ground connection of the transmitter and the antenna connection of the receiver.

1,214,620. Means for Producing Electrical Oscillations with the Aid of an Auxiliary Oscillation Circuit; G. Von Arco and A. Meissner, Berlin, Germany. App. filed Sept. 17, 1912; issued Feb. 6, 1917. Control of the spark tone or spark operation of a powerful working circuit by impressing high-frequency oscillations, generated in a separate ignition circuit, upon the main working circuit itself. The ignition circuit uses comparatively small power, and its periods of operation determine the time of sparking in the main circuit, thus giving control for Morse signaling, or alternatively, enforced regularity of spark production to give a pure singing tone in quenched-gap operation.

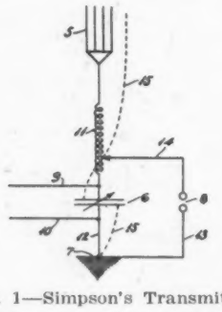


Fig. 1—Simpson's Transmitter

1,214,655. Wireless Telephone Apparatus; B. V. Deitz, Slingerland, N. Y. App. filed Oct. 15, 1913; issued Feb. 6, 1917. A crystal detector for radio-telephony or radio-telegraphy, in which a lump of silicon is clamped between pieces of zinc oxide and chalcopyrite. The triple crystal combination is said to form a minute voltaic cell, which produces a direct current when radio-frequency current is applied to the detector.

1,216,538. Means for Producing Electrical Oscillations; G. G. Arco and R. M. Rendahl, Berlin, Germany. App. filed March 18, 1909; renewed Jan. 8, 1917; issued Feb. 20, 1917. A spark gap for radio-telegraphic transmitters, comprising one or more short gaps between electrodes having high heat conductivity, such as silver plates having parallel faces. The construction described is that commonly known as the "quenched gap."

1,216,615. Apparatus for Producing Powerful Electrical Oscillations; G. Seibt, New York, N. Y. App. filed Dec. 27, 1909; issued Feb. 20, 1917. A spark transmitter for radio-telegraphy or radio-telephony, in which the coupling between primary and secondary is adjusted to cause a rapid decrease of the primary oscillations, and to produce substantially zero value of current amplitude in the primary circuit at the end of the first beat of oscillations. The gap cools rapidly, and therefore the primary circuit is opened at the end of the first beat. The antenna circuit thereafter oscillates freely, in accordance with quenched-gap practice.

1,216,646. Method of Producing High-Frequency Oscillatory Currents; J. C. Armor, Ingram, Pa. App. filed Oct. 14, 1911; issued Feb. 20, 1917. A radio-frequency oscillator, for use in radio-telegraphy, telephony, etc., in which radio-frequency currents are produced in a condenser circuit by impulses from a coupled driving circuit which contains a short spark gap having a high velocity fluid jet passing between its electrodes. The spark gap is so arranged that the currents in the impulse circuit are unidirectional or dead-beat.

1,216,647. Means for Producing High-Frequency Oscillatory Currents; J. C. Armor, Brooklyn, N. Y. App. filed Nov. 23, 1911; issued Feb. 20, 1917. Details of a spark gap for testing patent 1,216,646. One form comprises a pair of axially aligned hollow electrodes spaced apart to form a narrow annular gap, between the edges of which a stream of insulating fluid is radially projected.

1,216,720. Wireless Telegraph Transmitter of the Portable Type; M. A. Mulrony, Randwick, Australia. App. filed Jan. 23, 1915; issued Feb. 20, 1917. Uses a small rotary transformer of the inductor type, giving an output of about 200 watts at a voltage of about 18,000, with a frequency of from 50 to 100 cycles per second. The output of this small transformer-alternator is applied to a spark gap and radiating oscillation circuit in the usual way.

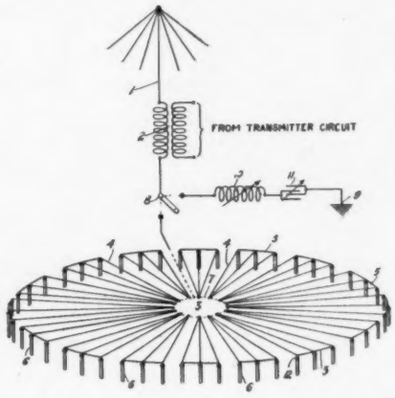
1,217,483. Transmitting Apparatus for Wireless Telegraph Stations; T. B. Miller, Seattle, Wash. App. filed Aug. 22, 1914; issued Feb. 27, 1917. A radio-telegraphic sender in which two condensers of a primary oscillation circuit are charged in parallel, through needle gaps and choke coils, and discharged in series at radio-frequency. The object is to increase the efficiency of production of radio-frequency current in the antenna.

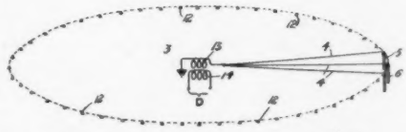
1,217,516. Transmitting Apparatus for Wireless Telegraph Stations; F. G. Simpson, Seattle, Wash. App. filed Nov. 24, 1915; issued Feb. 27, 1917. A sending apparatus for radio-telegraphy, in which the alternating-current output of a power transformer is rectified by the use of a mercury valve, and the rectified pulsations applied to the radio-frequency circuit condenser through a controlling resistance. The rate of charging the condenser is determined by its capacity and the resistance, and after full charge the condenser discharges with oscillations across the spark gap. Radio-frequency oscillations are thus set up in the antenna and ground circuit.

1,217,517. Radio-Telegraph and Telephone System; F. G. Simpson, Seattle, Wash. App. filed May 25, 1916; issued Feb. 27, 1917. A transmitter in which the antenna is connected serially to ground through an inductance and a condenser. The condenser discharges across the spark gap, which is connected between ground and a mode of potential on the inductance coil. Thus no potential exists between the electrodes of the spark gap while oscillations occur in the aerial circuit.

Discussion

Of the eleven radio patents issued during February, 1917, all but two are on inventions having to do with the transmitting station. Among the nine, No. 1,216,538, issued to Messrs. Arco and Rendahl, and No. 1,216,615, issued to Mr. Seibt, are of extreme interest in view of the present-day wide application of the so-called "quenched spark" method of transmitting. Radio engineers interested in this particular development who desire to read over these two specifications in full can secure copies from the Patent Office, consequently no further digest of them will be made here.





Figs. 2 and 3—Reuthe's Combined Antenna System

Patent No. 1,214,591, issued to G. Reuthe, for an antenna arrangement, is also one of the most interesting of this month's group. Fig. 2 is reproduced therefrom, and shows a tall vertical antenna 1, coupled by means of transformer 2 to the transmitting apparatus. At the base of the transformer is a switch 8 which alternately connects the antenna between the counterpois 3, and to a series inductance 10, capacity 11, and the ground 9. When the switch is in its vertical position, the transmitter may be used. When the switch arm is in a horizontal position, the large antenna is connected to ground and in the condition used for receiving. The receiving apparatus is not, however, coupled to the inductance 10, nor is the main antenna 1 used for receiving. As shown in Fig. 3, a portion of the counterpoise, such as the wires 4, 4, which are supported on the posts 6, is led to the primary of the receiving tuner 13. The other terminal of the receiving primary is grounded, and the secondary 14 leads to the oscillation detector system as usual. Thus a portion of the counterpoise itself is used as the receiving antenna. By means of inductance 10 and condenser 11